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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
Thirty-fourth Annual Meeting, New England Association of Gas Engineers 241

NOTICES—
Eleventh Annual Meeting, Michigan Gas Association 241
Third Annual Meeting, Wisconsin Gas Association 242

OFFICIAL NOTICES—
Premiums Offered, Ohio Gas Light Association 242
Novelty Advertising Department, Ohio Gas Light Association—Nos. I. and II. 242
Wrinkle Department, Ohio Gas Light Association 242

EDITORIALS—
Briefly Told 242
The Baltimore Calamity—Change in Date, Western Gas Association.
*The Didier-Stettiner System of Inclined Retorts in England: Its Installation at Plymouth, and Other Works Extensions and Improvements—Continued from Page 206. 243
*Service Connections, by "H. M." 246
*The Repulsion Type of Alternating Current Motor 247
"Invention" 250
Construction and Maintenance of Electric Current Carrying Wires. 251

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 252
The Proposed Gas Bills for New York City—Change in Corporate Title—The C. W. Hunt Company's New Catalogue—Inviting the Scholars to Write on Gas for Cooking—Annual Meeting, St. Paul, Minn.—Another Annual Meeting—Betterments at Kewanee, Ills.—New Office Quarters for the Fall River (Mass.) Company—Mr. J. M. Howe is the Other Boston Expert—Annual Meeting New Britain, Conn.—Mr. C. A. Tucker Goes to St. Louis—Report, Supt. Lamps, Boston, Mass.—And Other Items.

The Market for Gas Securities 254

[OFFICIAL NOTICE.]

Thirty-fourth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF SECRETARY,
EAST BOSTON, MASS., Jan. 28, 1904.

To the Members of the New England Association of Gas Engineers:
The Thirty-fourth annual meeting of this Association will be held at Youngs' Hotel, Boston, Thursday and Friday, February 18th and 19th, 1904.

The following papers and topics will be presented:

"Inclines," by Mr. C. F. Prichard, Lynn, Mass.

"Inclines," by Mr. C. H. Gifford, New Bedford, Mass.

"Testing Water Heaters," by Mr. A. J. Campbell, Norwich, Conn.

"Installation and Maintenance of Gas Arcs," by Mr. T. H. Hintze, Lowell, Mass.

"The Gas Engine from the Manager's Standpoint," by Mr. H. W. True, Boston, Mass.

You are also requested to discuss the following questions:

"What precautions are necessary to prevent firing in gas coal piles?"

"What co-operation or mutual benefit or profit-sharing schemes have been tried by New England Gas Companies? Upon what lines and with what success?"

"Is there any standard size of service pipe?"

"Depth of material in purifiers?"

"The use of gas for cremation?"

"What have been the permanent effects of the coal famine of 1902?"

"How does Texas oil behave in the New England climate?"

"What is the present state of electrolysis? How best handled and stopped?"

"What is the effect of different styles of station meter drums on capacity?"

"Does correction for temperature at station and photometer meters give correct figure of volume at 60°, especially at high temperatures?"

"What is the effect on candle power of compression to say 5 pounds?"

"How many practice preheating the oil in making water gas? Is anything gained by it, except with heavy oils, or even with them?"

"What is best form of tar overflow for hydraulic main?"

"How much sulphur is being furnished New England gas companies in their coal?"

"Are the high pressure systems meeting the expectations of their promoters?"

"How much saving is shown by the new 'rehandling' plants?"

Members are urged to bring with them to the meeting facts and figures bearing on the above, so the discussion thereon may be to the point.

The annual dinner will be at 6:30, Thursday evening. Your attention is called to the Library, which is now ready for your use at 715 Tremont Temple.

It is hoped that enough "Forms" will be received so that a display of them can be made.

If members will remit their dues before the date of meeting, it will be a help to the Secretary.

All friends of the Association are cordially invited to attend the sessions whether they receive a formal invitation or not, and to take part in the discussions.

N. W. GIFFORD, Secretary.

[NOTICE.]

Eleventh Annual Meeting, Michigan Gas Association.

MICHIGAN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
ANN ARBOR, MICH., Jan. 1, 1904.

The Eleventh Annual Meeting of the Michigan Gas Association will be held in Saginaw, Wednesday and Thursday, the 17th and 18th of February, 1904. The headquarters of the Association will be at the Hotel Vincent. The meeting is to be held in the parlors of the Saginaw Club. The following papers will be read:

"A Few Notes on Ammonia," by Mr. F. E. Sheriff, Battle Creek, Mich.

"The Laying of High and Low Pressure River Gas Lines," by Mr. H. C. Morris, Bay City, Mich.

"The Laying of Mains and Services and Recording of Same," by Mr. John Hellen, Grand Rapids, Mich.

"Care of Benches and Results Therefrom," by Mr. Thos. S. Whalen, Jackson, Mich.

LIBRARY OF CONGRESS SMITHSONIAN DEPOSIT

"Advertising: As Advantageous to the Gas Business," by Mr. A. P. Ewing, Detroit, Mich.

"A Report of Progress on the Study of Naphthaline," by Mr. Samuel Ball, University of Michigan, Michigan Gas Association Scholarship.

In addition to these papers, the Question Box will be made the feature of one session. Replies to all questions received are now in preparation.

A beefsteak supper will be served the members at the East Saginaw Club, on the evening of February 17th, by the Saginaw Gas Company.

Rates at the Hotel Vincent have been secured as follows:

Room without bath, for one person.....	$2.50	per day.
" " two persons.....	5.00	"
Room with bath, for one person.....	3.00	"
" " two persons.....	6.00	"

The Bancroft House is an equally good hotel, where similar rates can be obtained. Those desiring good accommodations should write in advance.

This meeting promises to be the best in the history of the Association, and every member is urged to be present. Members of other Associations, and gas fraternity in general, are cordially invited to meet with us.

H. W. DOUGLAS, Secretary.

[NOTICE.]

Third Annual Meeting, Wisconsin Gas Association.

WISCONSIN GAS ASSOCIATION,
OFFICE OF THE PRESIDENT,
RACINE, WIS., Jan. 17, 1904.

To the Members of the Wisconsin Gas Association: The Third Annual Meeting of the Wisconsin Gas Association will be held in Milwaukee, Wednesday and Thursday, Feb. 17th and 18th, with headquarters at the Hotel Pfister.

HENRY H. HYDE, President.

[OFFICIAL NOTICE.]

Premiums Offered, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY, DELAWARE, O.,
January 4, 1904.

It affords me very great pleasure to announce to the gas fraternity that, in connection with the Twentieth Annual Meeting of the Ohio Gas Light Association, which is to be held in Cleveland, March 16th, 17th and 18th, 1904, Mr. John D. McIlhenny, President of the Association, will offer the following premium for the best paper on "The Best Arrangement for Recovering and Utilizing the Waste Heat from Gas Benches."

Abady's "Gas Analyst's Manual."
Byrne's "Highway Construction."
Carpenter's "Heating and Ventilating of Buildings."
Carhart's "High School Physics."
Crooker's "Electric Lighting," 2 Vols. (1, Station; 2, Distribution).
Crafton, "Handbook of Practical Gasfitting."
Groves and Thorpe's "Gas Lighting."
Hughes and Richard's "Gas Works."
Johnson's "Engineering Contracts and Specifications."
Kent's "Mechanical Engineers' Pocketbook."
Patton's "Treatise on Foundations."
"Self-Instruction in Gas Manufacture."
Wagner's "Chemical Technology."
Newbigging's "Handbook for Gas Engineers."

Competition is open to all. A committee will be appointed and announced later to pass on the contributions and the decision of the committee will be made known at the meeting. Those desiring to enter this competition should have their paper in the hands of the Secretary not later than March 1st, 1904.

T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Novelty Advertising Department, Ohio Gas Light Association.—No. I.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY, DELAWARE, O.,
December 12, 1903.

The Editor of the Novelty Advertising Department, Mr. B. W. Perkins, of South Bend, Ind., desires to announce that his department is now open for contributions to be presented at the Twentieth Annual Meeting, which will be held in Cleveland, March 16th, 17th and 18th. This department is one of the most attractive features of the convention Its success, however, depends largely upon the active co-operation of the members. It is, therefore, earnestly hoped that the fraternity will not be backward in sending advertising schemes to Mr. Perkins.

T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Novelty Advertising Department, Ohio Gas Light Association.—No. II.

OFFICE OF THE EDITOR,
SOUTH BEND, IND., December 30, 1903.

The Executive Committee of the Ohio Gas Light Association has added to the Novelty Advertising Department a "New Business Methods Department," which, with the former, will combine any and all methods for furthering the business of gas companies. This will include any scheme or method that has been, or is being, used to further the sales or use of gas, coke, tar, gas fixtures, fittings, ranges, heaters, etc.; in short, all residuals and gas consuming appliances, whether for fuel or lighting purposes.

Contributions are requested from all, whether they are members of the Ohio Gas Light Association or not, as the proceedings are published and the use of any method mentioned is for the use of the fraternity at large. Contributions are requested to be sent as early as possible, as their arrangement and printing require considerable time.

Yours truly, B. W. PERKINS, Editor.

[OFFICIAL NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE SECRETARY, DELAWARE, O.,
December 28, 1903.

The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, St. Paul Gas Light Company, St. Paul, Minn., earnestly solicits the co-operation of the fraternity for contributions to be presented at the Twentieth Annual Meeting of the Association, which is to be held at the Hollenden Hotel, Cleveland, March 16th, 17th and 18th, 1904.

Editor Eysenbach will be pleased to receive contributions not later than February 15th.

T. C. JONES, Secretary.

BRIEFLY TOLD.

THE BALTIMORE CALAMITY.—The terrible disaster that came last week to the people of Baltimore, Md., is sufficiently in the mind of the world to now have lost none of its force, even in these days of swift and easy forgetfulness. The daily prints have detailed the particulars of the awful happening, so it is here unnecessary to dwell upon them, nor may it sound well to say, "I am better than you;" but we are thankful to report that out of the disaster the gas industry of Baltimore may be congratulated upon its emergence. The Consolidated Gas Company's offices were destroyed, and great damage, of course, was occasioned to its distributing system—thousands of meters and miles of mains and services were rendered useless—but the plants are intact, and a fairly good supply of gas is being maintained in certain sections of the city. The Company, the day after the flames were stayed, opened business offices in the residence structure, 602 North Charles street, and Manager Miller and his men are at work in the way that only men of heart may toil. The shops of the Maryland Meter Company, although perilously close to danger, were saved, but its local or main office was destroyed. The Baltimore Retort and Firebrick Company also came out scatheless, as did the main properties of the world-wide known manufacturing firm of Bartlett, Hayward & Co., although its offices, too, went with the flames. The properties of the United Electric Light and Power Company were blotted out unfortunately, the destruction of which caused much confusion in the way of public and private lighting and in street railway travel; in fact, the latter is virtually at a standstill. Regretting the extent and misery of the disaster, it is a weakminded one who may not heartily join in the thought, it might have been worse.

CHANGE IN DATE, WESTERN GAS ASSOCIATION MEETING.—We are officially informed by Mr. James W. Dunbar, Secretary of the Western Gas Association that the returns of the mail vote, on the proposition to change the date of the meeting of the Western Gas Association from May to June, were so greatly in favor of the change that the latter has been agreed upon by the executives. The meeting, then, will be held in St. Louis at some date in June to be determined shortly.

[Continued from Page 206.]

The Didier-Stettiner System of Inclined Retorts in England: Its Instaliation at Plymouth, and Other Works Extensions and Improvements.[1]

Leaving the house structure, we have now to deal with the settings, of which some striking views were taken during erection (Figs. 2 to 6).

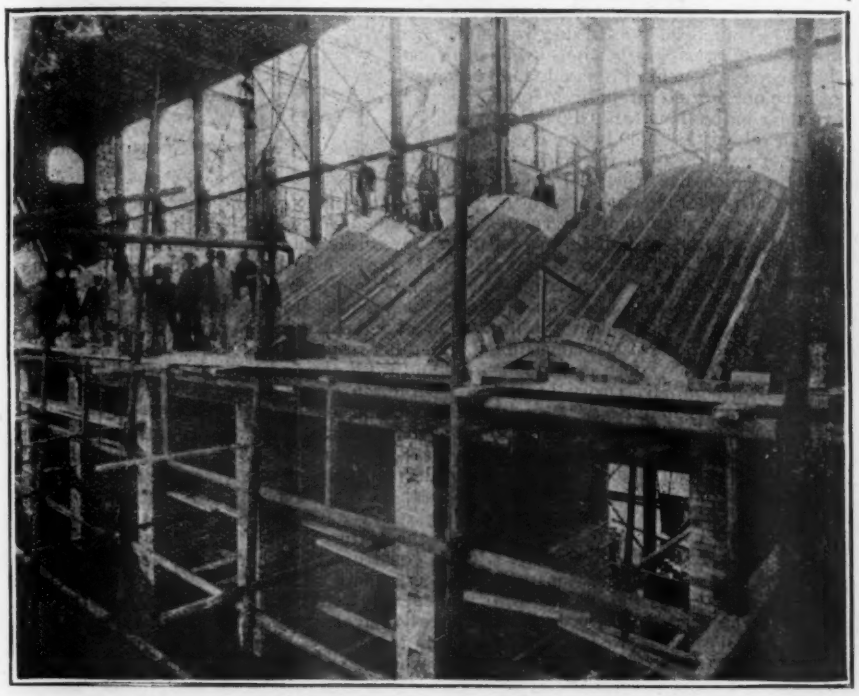


Fig. 3.—Retort Arches in Course of Construction.

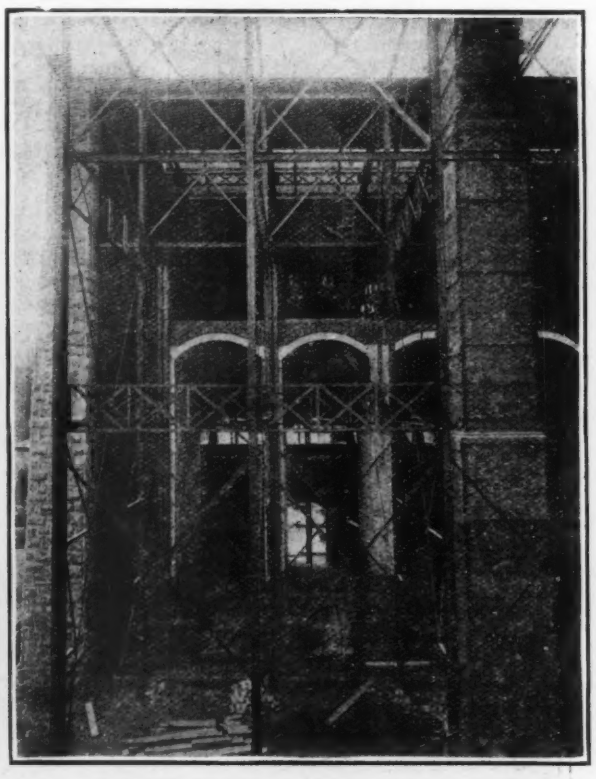


Fig. 4.—Back View of Arches through the Arcade.

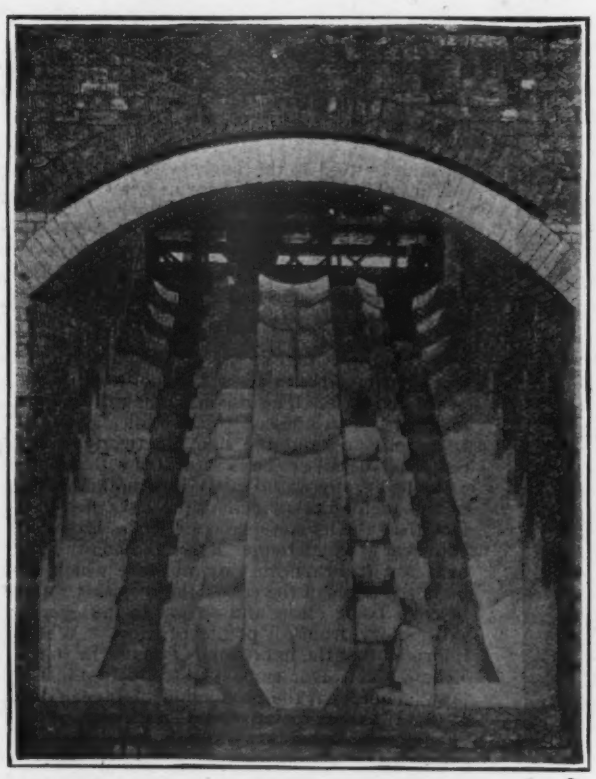


Fig. 5.—One of the Settings, Showing the Fireclay Block Work.

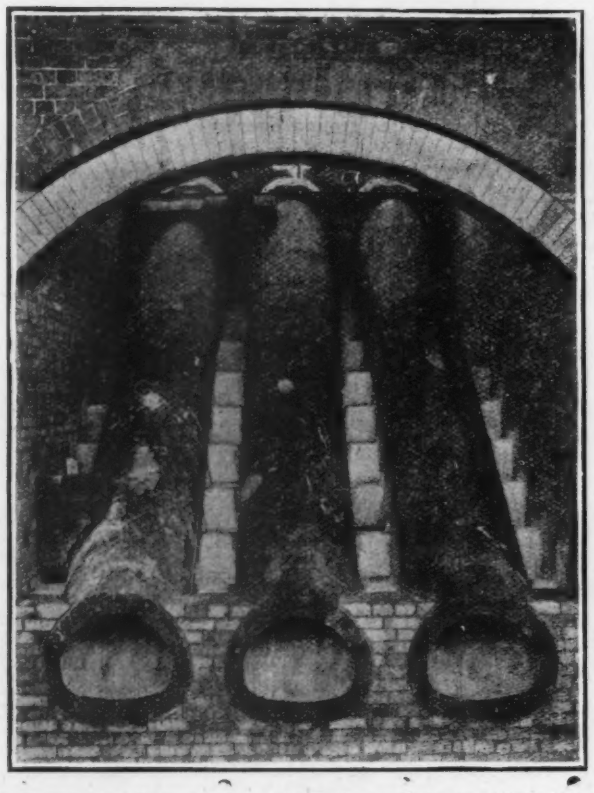


Fig. 6.—Three Bottom Retorts in One of the Settings, with the Special Blocks between.

The main division walls are built of Stourbridge firebricks; but the chief feature about the Didier settings is (without particularizing the system of construction) not only the quality of material used, but the complete use made in the composition of the interior work of specially moulded fireclay blocks for every position; so that there is really very little brickwork used in the structure. This results in a fewness of joints when compared with settings built entirely of firebricks, and all chipping and consequent injury are avoided. The furnaces are unusually deep, being some 3 feet deeper than the ordinary English setting; and special arrangements are made to prevent any cold air getting into the settings during clinkering or charging operations. The heating of the secondary air is very simple and effective; the bottom waste gas flue being completely black. The tiles of which these flues are made are rabbeted into each other, in order to prevent any bye-passing of either the gases or the air supply. Another feature is that the furnaces are supplied by steam from a boiler situated in the flue at the back of each setting. These are plain, wrought iron boilers, heated by the waste gases; and the steam from them passes from the back to the front of the setting, and enters on each side of the ash pan with the primary air, so that a continuous current of steam is blown along the whole length. It is Mr. Hoyte's experience that, owing to the even distribu-

1. *Journal of Gas Lighting.*

tion of the steam, and the constant light pressure, he gets out the clinker in a softer and smaller form from back to front of the furnace than by the usual means. Such regularity as is experienced here in this respect is not to be obtained by a hand operated valve. Then above the boiler is a doorway leading into a chamber at the back of the setting, where the dampers conveying the generator gases to the various parts of the setting are regulated. The bracing of the settings is composed of 15 inches by 6 inches vertical joists and 2¼-inch tie bars. In Fig. 2 will be seen two of the bottom the rods, one in position, and the other ready for lowering. The chimneys, of which there are two, are situated in the central arcade. Their height is 75 feet; and they are carried up the whole distance with the same inside section—4 feet square. Provision has been made in these chimneys for the second half of the house.

The bench in this first half of the house consists of 8 beds of 9 retorts each, 20 feet long, by 23½-inch by 15½-inch parallel, and of the oval-Ω form; and, as already stated, they are capable of producing 1½ million cubic feet of gas per day. The retorts are made of special Stettin material, capable of standing a working temperature of 3,500° F., and are glazed inside with a material which will stand even a higher temperature.

Regarding the bench fittings, the ascension pipes are 7 inches in diameter; and above the mouthpieces, they are each provided with an expansion joint. About two-thirds of the way up are self sealing cleaning out doors, as well as on the top of the bridge pipes (Fig. 7).

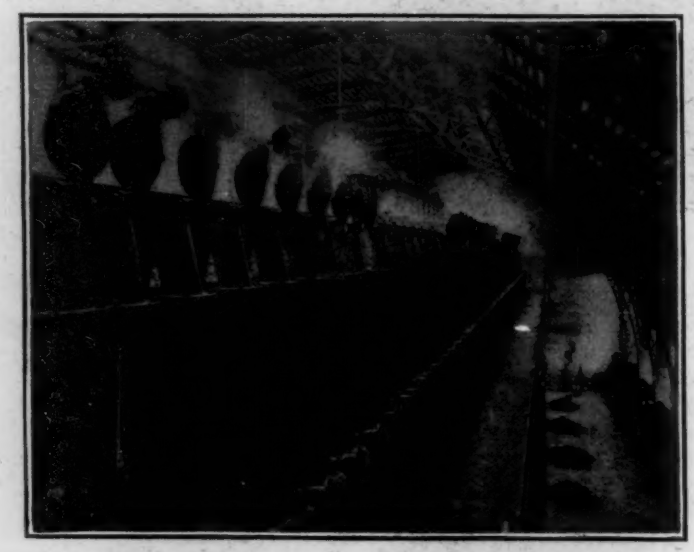


Fig. 7.—Cleaning Out Doors of the Ascension and Bridge Pipes, with Platform in Front of the Ascensions.

These doors, which fasten in the same way as retort mouthpieces, are the invention of Mr. Drory, as is also the form of the hydraulic mains and valves, which, unlike English settings, are placed on a level with the higher part of the setting, instead of close to it at the lower part (Figs. 8 and 9). The hydraulic mains are also fitted with cleaning out

Fig. 8.—Superstructure of the Bench in Course of Construction. A Good View of the Roof Work.

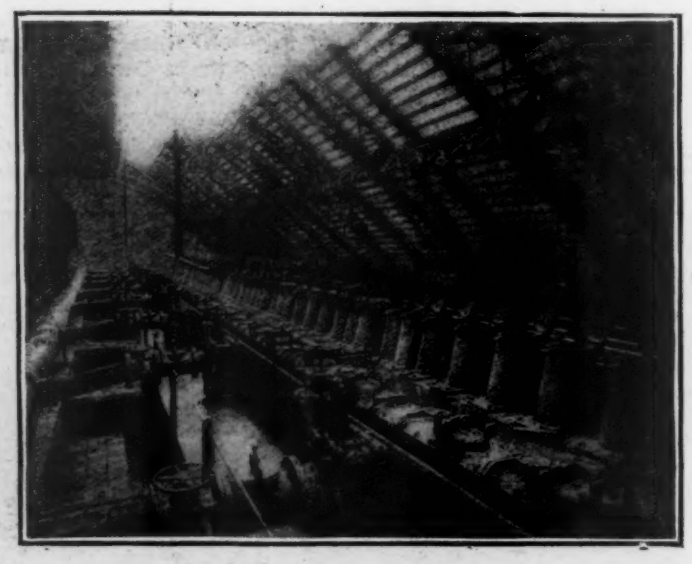


Fig. 9.—On Top of the Bench, showing the Arrangement of Hydraulic Main, Pipe Work, Cleaning Out Doors.

doors, and with an internal division plate passing down in a slanting direction the whole length, and sealed at the bottom; so that, through the cleaning out doors, any obstructive tar can be removed without discomfort, while gas making is proceeding. Adjusting screws are provided for the levelling of the mains in the event of any sinking of the bench occurring. The gas and tar are taken off together; and from the foul main, the former passes on to a set of annular condensers at the south end of the house. These consist of six annular tubes; the outer tubes being 4 feet in diameter and the inner ones 3 feet 2 inches. Their height is 40 feet. There is a disk valve at both ends; and the connections and valves (with bye-pass arranged) are 20 inches in diameter. The condensers are also furnished with butterfly valves regulating the flow of air up the inner tube. The tubes stand on granite bases.

While inspecting the superstructure of the bench, one is impressed with the evidence that abounds everywhere of the amplitude of the provision that has been made for giving attention, with a minimum of trouble, to the upper part of the equipment of the house. There are the cleaning-out doors on the ascension and bridge pipes and on the hydraulic mains, all of which can be instantly opened by hand. Then along the front of the ascensions is fixed a platform 2 feet 6 inches wide; and, reached by a spiral staircase from the discharging floor, every part of this upper work of the bench is readily accessible. In fact, from ground floor to coal hoppers the whole house can be walked over, without any climbing of vertical, or almost vertical, ladders.

A few words, before touching the coal plant, as to the discharging and charging floors. The former is of good area, being some 20 feet wide (Fig. 10). The framework is of rolled steel joists, 10 inches by 6 inches, supported on 18 cast iron columns, about 13 feet long. The floor itself is composed of coke breeze concrete arches, paved with Staffordshire blue brick. It is reached from the ground floor by a stairway situated by the wall almost midway in the length of the house. The charging floor can be reached from the discharging stage at either end of the house by iron stairways. This floor is unique among inclined retort house charging stages in this country. As already stated, it is open completely to the central arcade, with the exception of a temporary row of galvanized iron sheets placed obliquely to protect the men from the rain; but these will not be needed when the second part of the house is built. This openness of the stage renders unnecessary any great width; and, as a matter of fact, from the hand rail to the front of the bench it is only some 11 feet wide. Here again we find a departure from English construction. In installations hitherto, the charging stages are supplied with a movable platform on wheels for the men to examine or give attention to the top line of retorts. In this case the stage is a double one (see Fig. 11); the upper floor (which is only 7 feet 6 inches wide) being some 2 feet 6 inches above the lower one, or just about level with the tops of the bottom retorts. It is on the former that the whole of the work is done; and from it one can see into all three ranges of retorts. The space between the platform and the front of the setting is about 3 feet 6 inches; and the draught which is set up between the platform and floor causes the smoke and gases issuing from the retorts during charging to be taken up in a vertical direction, instead of being blown out on to the men. The retorts are fed by measuring chambers on the shot-

Fig. 10.—The Discharging Floor, Showing also the De Brouwer Conveyor.

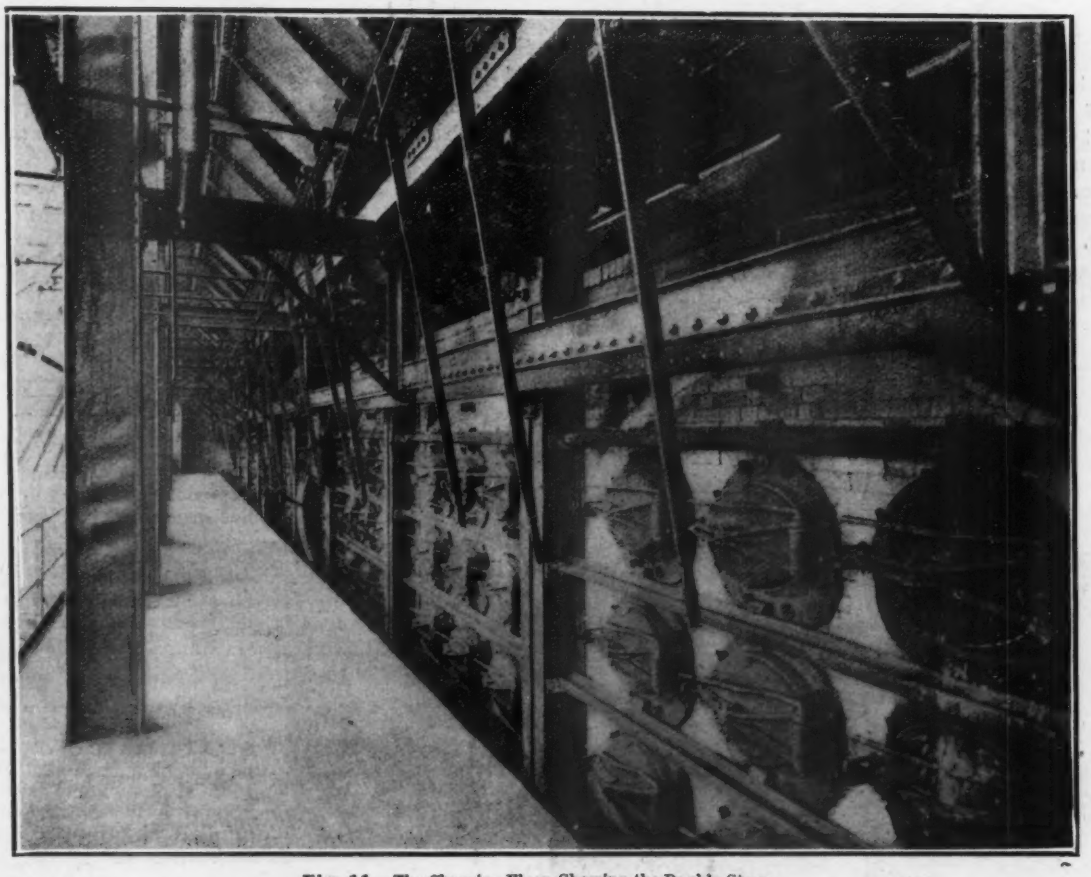


Fig. 11.—The Charging Floor, Showing the Double Stage.

pouch principle, with levers top and bottom, and the usual set of travelling shoots. It will be a point of interest to mention that the bottom lever has been set in somewhat, so that the man charging is close to the retorts, and can keep an eye on what is going on in them, and so is able to better regulate the charges.

In inspecting the coal plant, it is found at the outset that the Company suffers one disadvantage in respect of its coal supply. The coal used is all sea borne, and it has to be carted from the wharf to the works—a distance of some 500 or 600 yards. The coal comes in shiploads at fairly regular intervals, but with pauses between. It is, therefore, necessary to arrange a store to take up the surplus amount supplied while the ship is unloading, so as to supply the retort house between the times when no ships are in the harbor. From the carts the coal is dumped into an underground hopper (capable of holding 2 or 3 cartloads of coal) situ-

ated at one end of the coal store, which, as stated early in the article, was formerly No. 4 retort house. It is 120 feet long by about 60 feet wide. Underneath the hopper there is arranged a slide for shutting off the supply to the breaker and elevator when required; and this slide is worked by means of a shaft placed in a convenient position on the floor level. After passing through the mouth of the hopper, the coal enters a single pair claw breaker, capable of passing from 40 to 50 tons of coal per hour. After going through the breaker, the coal falls into the boot of an elevator, which raises it to the level of the tie rods of the roof of the coal store, and there delivers it on to a travelling band conveyor 2 feet 6 inches wide (Fig. 12). This band conveyor is supported overhead and is capable of elevating from 20 to 30 tons of coal per hour. The conveyor is of the latest pushplate design, with the chain and pushplates supported on rollers running on the frame of the conveyor, so that very little noise is made by the conveyor in working. The continuous hopper is of 140 tons capacity, which is about equal to the requirement of 24 hours' work; and it can be replenishcd easily in 9 hours by the coal plant just referred to. In a room adjoining the coal store is found a 22-horse power "National" gas engine, which drives the ground conveyor. the elevator to the retort house and the pushplate conveyor over the storage hopper. In this room, too, is seen a small engine and dynamo, with accumulators and battery of 55 cells, for the

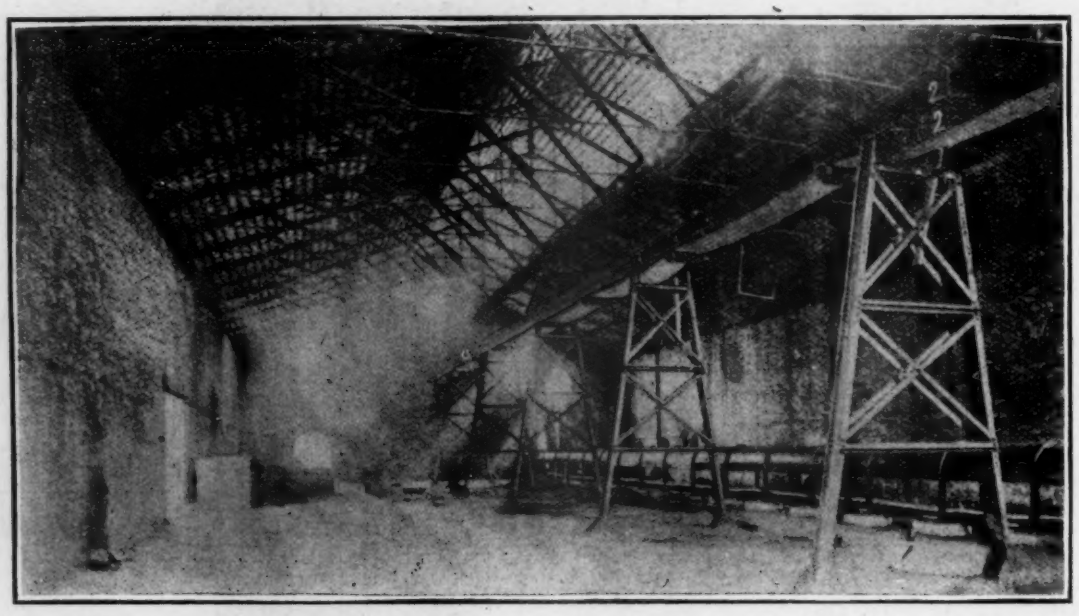


Fig. 12.—The Coal Store, with Distributing and Ground Conveyors.

on lattice standards in the coal store throughout its length; and a travelling throw-off carriage is arranged on the frame of the conveyor by which the coal can be thrown off at any desired part of the store, which, in this way, can be filled to the level of the bottom of the conveyor without trimming or other attention. For taking the coal out of store, a second band conveyor has been arranged in a tunnel covered with steel plates close to the floor of the store; the tunnel being provided with suitable doors and shoots inside to feed the coal on to the 2-foot 6-inch band. By this band the coal is delivered to the boot of the elevator leading to the retort house plant. This consists of the elevator (Fig. 13),

Fig. 13.—The Elevator from the Coal Store to the Retort House.

which is cased in, and is about 85 feet centers, arranged at an angle across a roadway between the coal store and the retort house; the elevator being of such a length as to enable the coal to be de delivered to the push plate conveyor which passes over the continuous hopper above the charging stage. The elevator is fitted with 12-inch buckets, lighting of the purifying house, which has yet to be described. At the further end of the coal store is a second gas engine of like horse power for driving the coal breaker, the main elevator and the distributing conveyor.

(To be Continued.)

Service Connections.

By H. M., in *The Metal Worker*.

Reference to a service connection with the street main in *The Metal Worker* some time since suggests that a description of two methods of doing such work, that have proved satisfactory, would be valuable to those who are occasionally called upon to do this work in connection with large, isolated jobs depending on private reservoirs for supply.

If the main is old, and care is taken to place the service on undisturbed earth at every point possible in the neighborhood of the main, no other especial care is neccssary when full weight lead pipe is used. Straight, stiff connections are never made, for the reason that some surplus pipe is needed to meet the drilling conveniently and to allow either main or service to settle freely, and also to provide enough pipe to make repairs on in case of having to wipe on a new ferrule or cock, or repair a pick hole made accidentally when digging for another service. This surplus pipe, if disposed of as shown in plan view in Fig. 1, will take care of

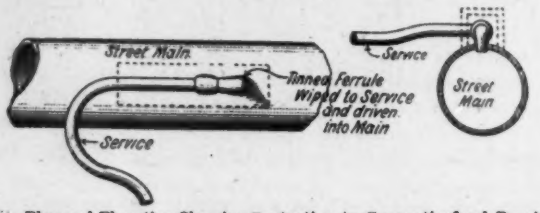


Fig. 1.—Plan and Elevation Showing Protection to Connection and Provision for Expansion.

settling on old or new mains. When the main and service pipes are both being installed at the same time some workmen place a saddle of 3 pieces of board, nailed together, over the pipe above the main, as shown in Fig. 1 by the dotted lines. In new work both pipes will settle some-

what, but the main will settle more than the service unless the ground is firm and the main carefully placed. Under ordinary circumstances extra precautions in this direction are more expensive than the work of digging np and repairing a service occasionally.

The writer was employed in the building of a water works having 1,000 service pipes to begin with. The ground was known to be soft and treacherous, and it was decided to carry all the service pipes under the main and connect as shown tn Fig. 2. This method was strictly adhered

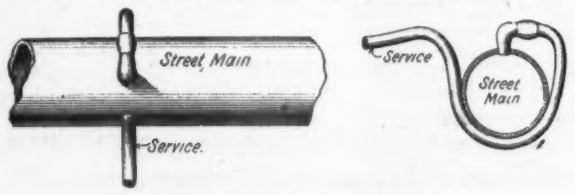


Fig. 2.—Connection for Soft Ground.

to, and no trouble has ever been experienced with the service pipes, although a dozen years have passed.

A style of corporation cock for use in the line under pavement is shown in Fig. 3. This cock is used by a company having over 20,000

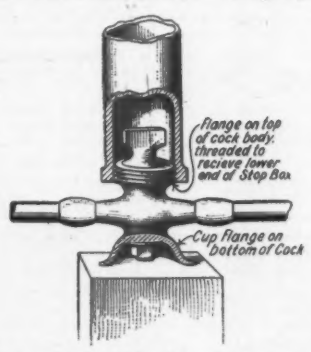


Fig. 3.—A Stopcock with Key Box Attachment.

services. The bottom section of the extensible box is threaded and the cock has a flange cast on the body around the key. It is threaded to fit the box. The body of the cock has a flange cup at the bottom to protect key from strain. The cock is set upright and at right angles to the property line, as usual, and the bottom section of the box is screwed onto the upper flange. This insures that the key head will always be in the box and perfectly upright in the center of the space. It is impossible for the cock to get out of alignment, and no dirt can ever get in at the bottom. Much trouble and expense are saved both to the water company and the plumbers in this way.

When iron service connections are made, as is regular in gas work, a single swing is made with two male and female elbows, when the main is old or in firm ground. If rapid settling of the main is anticipated an elbow and nipple is added to the two service elbows to make a double swing. In either case the service line travels in the dirt more or less while settling, and it should never be propped in place on the

Fig. 4.—Iron Pipe Connections with Provision for Movement Due to Settling.

swing side of the line. Fig. 4 illustrates the single and double swing described above.

The Repulsion Type of Alternating Current Motor.

In a paper presented last week before the American Institute of Electrical Engineers, entitled, "The Alternating Current Railway Motor," Mr. C. P. Steinmetz, after referring to the early work of the late Rudolph Eickemeyer with the single phase alternating current motor, gave in extenso the theory of the Thomson repulsion type of motor.

In introducing the paper Mr. Steinmetz said that for electric railway work a motor is required which maintains a high value of efficiency over a wide range of speed. That is, the torque per ampere input at constant impressed voltage must increase with decrease of speed, the speed increasing with decrease of load.

In electric motors, torque is produced by the action of a magnetic field upon currents flowing in an armature movable with regard to the field. If then the field is constantly excited—shunt motor on constant potential—the torque is approximately proportional to the current, the speed approximately constant at all loads. If the field is excited by the main current of the motor—series motor on constant potential—the field strength and thereby the torque per ampere varies approximately proportional to the current, and thereby the load, the whole torque approximately to the current, and thereby load, the whole torque approximately proportional to the square of the current and the speed inversely proportional to the current, leaving saturation out of consideration. That is, the motor has the characteristic specified above for a railway motor.

Since the direction of rotation of the direct current motor is independent of the direction of the impressed e.m.f., with laminated field the direct current motor can be operated with alternating currents. By the use of alternating currents it becomes possible to transfer current from circuit to circuit by induction, and instead of passing the main line current through the armature of the alternating current motor, the armature circuit can be closed upon itself and the current induced therein as transformer secondary by a stationary primary coil in the main circuit surrounding the armature.

The condition of operation of the direct current motor type on alternating current is, however, that the current in field and armature reverses simultaneously. This is by necessity the case in the series motor. In the shunt motor, however, the armature current as energy current should be in phase with the impressed e.m.f., while the field current as magnetizing current lags nearly 90°. To bring it back into phase, Stanley tried condensers in series in the field circuit, but failed, due to the impossibility of neutralizing the self induction of the field which varies with the commutation and the frequency, by the negative self induction of the condensers, which varies with the frequency in the opposite direction. The solution of the problem has been found in the use of polyphase systems, by utilizing for the field excitation the e.m.f. in quadrature with the armature currents acted upon by the field magnetism. Mr. Steinmetz says that as he has shown elsewhere, the polyphase induction motor can be considered as a development of the direct current shunt motor for alternating current circuits, and indeed has all the shunt motor characteristics regarding speed, torque, etc. As a railway motor the induction motor has therefore not been exploited, although it has been strongly recommended in those very few cases where it appeared good engineering. Experimental work with polyphase induction motor railways has been carried on continuously since 1893.

While in the early days of alternating current motor development, all other engineers were industriously developing the type with shunt motor characteristic, Rudolph Eickemeyer, of Yonkers, alone was farsighted enough to realize the absolute necessity of the series motor characteristic for railway work and undertake the development of the single phase alternating current series motor. Mr. Steinmetz added that he had the good fortune at that time to be associated with Mr. Eickemeyer.

As was pointed out by Kapp, in 1888, the power factor of the alternating current series motor is inherently low, since the same magnetic flux which induces, proportional to the frequency of rotation, the e.m.f. of useful work in the armature conductors, induces in the field coils an e.m.f. of self-induction, proportional to the frequency of alternation, thereby giving the armature the same number of turns as the field (which is more than permissible in good practice, since good practice requires weak armature and strong field). Even at synchronous speed the e.m.f. of rotation of the armature would still only be equal to the e.m.f. of self-induction of the field; and the power factor, allowing for an additional self-induction of the armature, would be below 70 per cent. This probably deterred the other engineers from considering the alternating current series motor.

Eickemeyer solved the difficulty by designing the armature with a number of turns several times greater than the field (25 to 7 in the first motor built) and neutralizing the armature self-induction and reaction by a stationary secondary circuit surrounding the armature at right angles electrically to the field circuit (the "cross coil," as he called it), and either short circuited upon itself or energized by the main current in opposite direction to the current in the armature.

In January, 1891, Mr. Steinmetz tested the first motor of this type, a bipolar motor with the following constants:

Field: Two coils of 14 turns No 10 B. S. wire, connected in parallel. Armature: 24 coils of 4 turns each of No. 12 B. S. wire. Secondary circuit: Two coils of 18 turns each of No. 10 B. S. wire connected in parallel.

At 100 cycles and 150 volts impressed e.m.f. this motor gave a three-

fourths synchronous speed, and its starting current at 150 volts and 70 amperes.

Current: 45 amperes. I^2R: 400 watts. Hysteresis and eddy currents: 900 watts. Total output, including friction: 4,000 watts.

Hence the efficiency was 75.5 per cent., and the power factor, 79 per cent.

As a bipolar motor with the very high frequency then used, the speed, 4,500 revolutions at three-fourth synchronism, was undesirably high, so immediately an 8-polar motor was built. In this, solid copper rings were used as secondary circuits surrounding the armature and neutralizing its self-induction, with an effective copper section more than four times that of the armature conductors. The ratio of armature series turns to field series turns was about 4. This motor was tested in 1892. The record of tests is given in Fig. 1, the observed values being marked

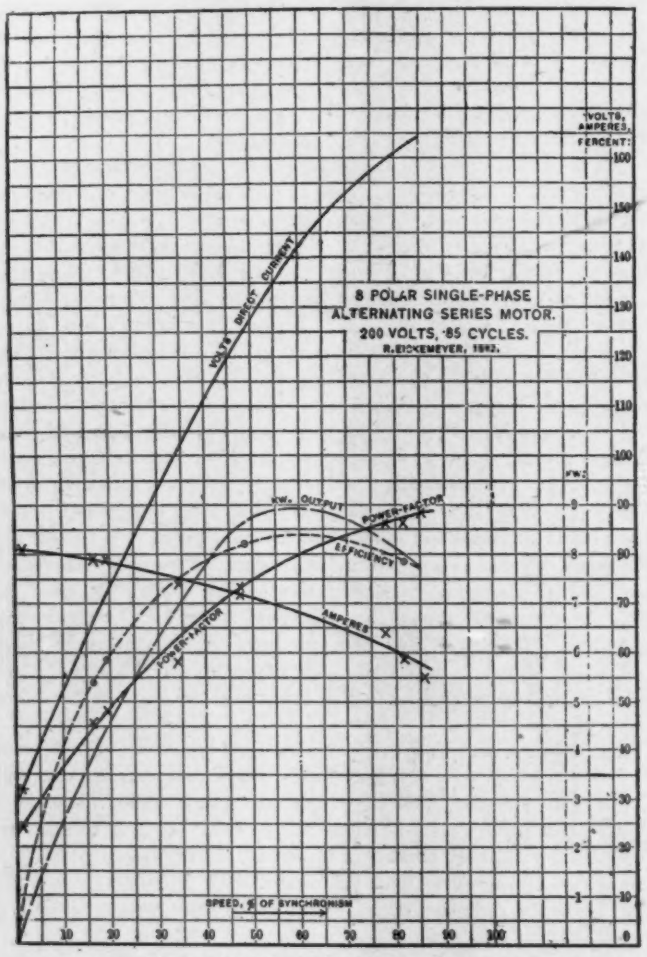


Fig. 1.—Test Curves of Eickemeyer Motor.

on the curves. For comparison on this sheet is also given the direct current voltage required to operate this motor at the same speed and current.

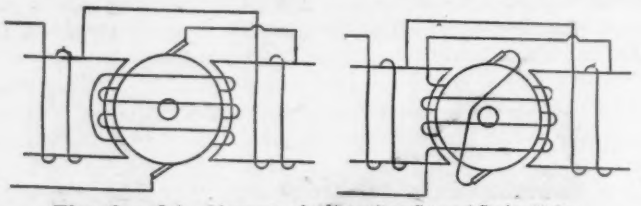
As will be seen, when approaching synchronous speed, the power factor is nearly 90 per cent. The commutation was fair at 85 cycles, the highest frequency at which the factory engine was able to drive the alternator, and attain at 33 cycles.

A number of railway motors of this type were designed. The great difficulty, however, was that during these early days 125 to 133 cycles was the standard frequency in this country, 60 cycles hardly considered, and 25 cycles not yet proposed.

The efficiency of this alternating current series motor is slightly lower than that of the same motor on direct current circuit due: (1) To the hysteresis loss in the field. (2) The hysteresis loss in the armature core, which is of full frequency up to synchronous and of still higher frequency, the frequency of rotations, beyond synchronism. (3) The I^2R loss in the short circuited secondary conductors surrounding the armature.

As will be seen, to make the alternating current series motor practicable, the transformer feature must be introduced, by having its armature as primary circuit closely surrounded by a short circuited secondary circuit, as shown diagrammatically in Fig. 2.

Instead of closing the stationary circuit upon itself as secondary circuit and feeding the main current into the rotating armature as primary circuit, mechanically the same results would obviously be obtained by using the stationary circuit as primary energized by the main current and closing the armature upon itself as secondary by short circuiting the brushes and thereby keeping the main current and the line potential away from the armature, as shown diagrammatically in Fig. 3. This introduces the great advantage of reversing the sign of the un-



Figs 2 and 3.—Diagrams of Alternating Current Series Motor.

compensated part of the armature self induction, so that it is subtractive, which results in an essential improvement of the power factor, especially at low speed.

This is shown in Fig. 4, where with the speed as abscissas, in per

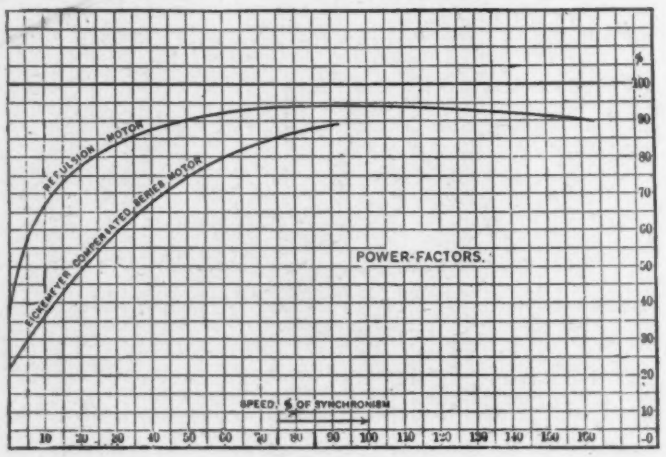


Fig. 4.—Power Factor Curves.

cent. of synchronism, are plotted the power factor of the Eickemeyer compensated series motor of Fig. 1, of ratio armature to field = 4, and the power factor of one of the first railway repulsion motors, of ratio armature to field = 3.5.

The compensation of the armature self induction in Fig. 3 is based on the feature of the transformer that primary and secondary current are in opposition to each other. The secondary current of the transformer, however, lags slightly less than 180° behind the primary current; that is, considering it in the reverse direction, is a leading current with regard to the primary current. The current in the armature in Fig. 3 is, therefore, a leading current with respect to the line current, and so not only does not add an additional lag but reduces the lag caused by the self induction of the field exciting coil.

This motor then consists of a short circuited armature surrounded by two coils at right angles with each other and connected in series, as illustrated in Fig. 5; the one A_2, parallel with the effective armature

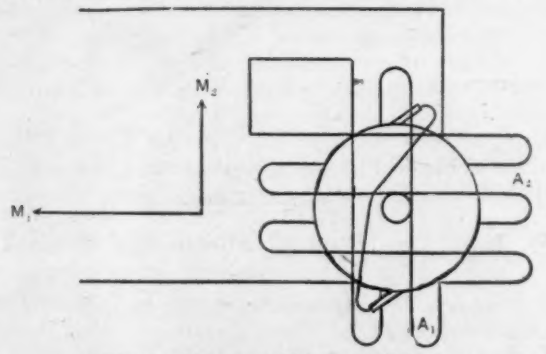


Fig. 5.—Diagram of Eickemeyer Motor.

circuit, acting as primary of a transformer to induce the secondary armature current; the other A_1, the field exciting coil. The ratio of turns of the coils, n_2 to n_1, is the ratio of effective armature series turns to field turns, as discussed before. Obviously, these two coils can be replaced by one coil at an angle with the position of brushes as shown in Fig. 6, and the cotangent of the angle of the axis of this coil with the position of the brushes is above ratio; that is, the smaller this angle the greater is the ratio of armature to field turns; that is, the bet-

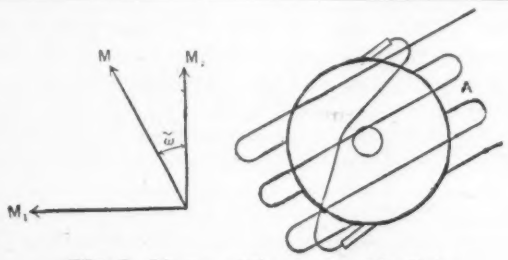


Fig. 6.—Diagram of Thomson Repulsion Motor.

ter the power factor of the motor. This motor is Professor Elihu Thomson's repulsion motor.

In the armature an e.m.f. is induced by the alternation of the magnetic field, M_2, of coil A_2, proportional to M_2, and to the impressed frequency and in quadrature with M_2, and an e.m.f. is induced by the rotation through the magnetic flux M_1, of coil A_1, proportional to M_1 and to the frequency of rotation and in phase with M_1. These two e.m.f.'s must be equal and opposite, since the armature is short circuited (neglecting the resistance and self inductive reactance of the armature) and at synchronism. Therefore M_1 and M_2 are equal and in quadrature with each other; that is, in the armature of the motor, Fig. 5, and therefore of the repulsion motor, Fig. 6. At synchronism a uniform rotating field exists and the hysteresis loss in the armature core is therefore zero at synchronism and at other speeds proportional to the difference between speed and synchronism; that is, to the slip, just as in the polyphase induction motor, while in the motor, Fig. 2, the hysteresis loss in the armature core is proportional to the impressed frequency or the frequency of rotation, whichever is the higher frequency. The hysteresis loss of the repulsion motor is, therefore, lower than that of the same motor as compensated series motor.

In Fig. 6 the magnetic flux in line with the brushes, which does not induce e.m.f. by rotation but only by alternation, is denoted by M_2; the magnetic flux in quadrature with the brushes which induces e.m.f. in the armature by its rotation but not by the alternation of the flux, by M_1; and the magnetic flux in the axis of the primary coil A, which is much nearer to M_2 than to M_1, since a good power factor requires a small angle ω, by M. Mr. Steinmetz then shows mathematically that M_1 and M_2 are in quadtrature in phase and the ratio of their intensity is inversely proportional to the ratio of speed to synchronism. Fig. 7

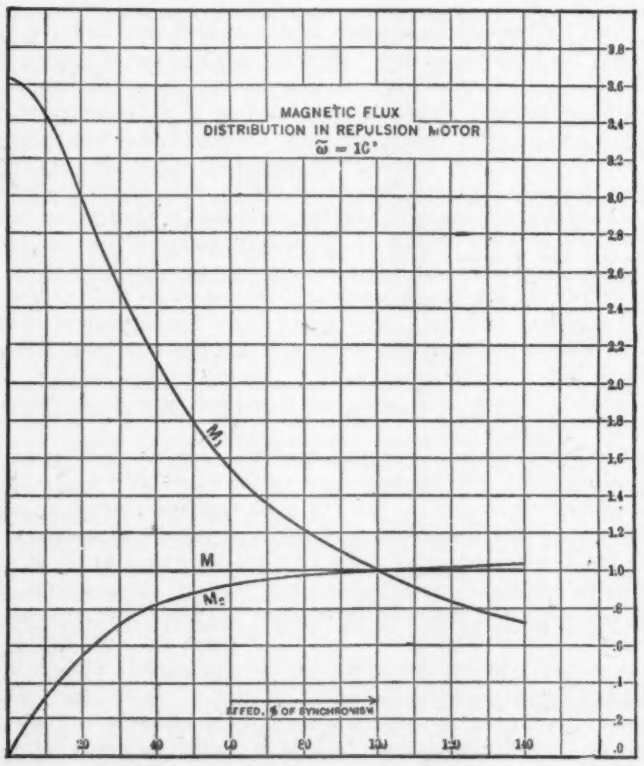


Fig. 7.—Magnetic Distribution in Repulsion Motor.

shows the two quadrature components, M and M_2 of the magnetic field of the repulsion motor for $\omega = 16°$ and $M = 1.0$.

That is, in the repulsion motor an elliptically rotating field exists which becomes circular; in other words a uniformly rotating field, at synchronism. Below synchronism the component M_1, which induces e.m.f. by the rotation of the armature is greater than M_2, the more the lower the speed. The flux M interlinked with the primary coil is, however, nearer to M_2 and therefore below synchronism, especially at low speeds. The magnetic flux which induces e.m.f. by the rotation of the armature and so represents the useful work, is greater than the magnetic flux which interlinks with the primary coil and so gives the lag of the primary current. This accounts for the high power factor of the repulsion motor at low speeds.

The paper then proceeds to give a theoretical investigation of the repulsion motor considered as a transformer, the secondary of which is standing at a constant angle ω with regard to the primary, so that motion results from the repulsive thrust existing between primary and secondary.

One of the deductions is that, unlike the plain series motor, which can never return power into the line, the repulsion motor when reversed becomes a generator, consumes mechanical power as brake and returns electric power into the line, even at low speeds. Experiment verifies this feature.

In discussing the mathematical theory developed, it is stated that the primary exciting, primary self inductive and secondary self inductive impedances have been assumed as constant. While this is approximately the case in the ordinary induction motor, it is not the case with the repulsion motor which works over a wide range of magnetic flux densities.

With increasing load and thereby increasing current and decreasing speed, magnetic saturation is approached and causes a decrease of the impedances, which has to be taken into consideration in predetermining the characteristic curves of such a motor. Furthermore the different component magnetic fluxes are affected differently by saturation. The flux, M, interlinked with the primary coil is approximately constant and therefore affected by saturation only indirectly, while the flux, M_1, at right angles to the line of polarization of the secondary coil is approximately proportional to the load and so reaches saturation at high loads, and the impedances become thereby different in the different directions of the magnetic structure.

The m.m.f.'s in the investigation were treated as vector quantities, independent of their distribution around the periphery of the armature. This distribution, however, is different with the different m.m.f.'s. The m.m.f. causing the effective flux, M_1, is due to a zone of the primary winding within the angle $\pm\ \omega$ from the axis of the secondary coil, hence nearly a concentrated winding, which gives a flat topped flux distribution, while the flux, M_2, in the direction of the axis of the secondary coil is that of a distributed winding or peaked. For the same m.m.f. the effective flux, M_1, is, therefore, greater than the effective M_2. Taking this into consideration, gives the motor somewhat better characteristics than calculated above. Owing to the different wave shapes of the fluxes, M_1 and M_2, they are affected differently by saturation. The flat topped flux M_1 reaches saturation at a much higher value, but then over the whole range, while the peaked flux M_2 shows the effect of saturation at a lower value but then gradually, by a rounding off of the peak. In the repulsion motor it is therefore not sufficient merely to consider the resultant m.m.f.'s as vectors, but their distribution in the air gap and the effect of saturation must be taken into consideration in the calculation and design of the motor. Mr. Steinmetz adds that an exhaustive investigation of this point has been made by his assistant, Mr. M. Milch, and may be communicated at a later date.

The secondary circuit of the motor has been considered as the seat of two e.m.fs. induced respectively by the rotation through flux M_1 and by the alternation of flux M_2. These e.m.f.'s., however, have no separate existence. At synchronism, for instance, the magnetic field is an approximately uniformly rotating field and, therefore, no e.m.f. is induced in the armature conductors except that required to overcome the resistance. The secondary frequency varies with the load and thereby the secondary self-inductive reactance which we assumed as constant in the preceding discussion. Mr. Steinmetz says this is best taken into consideration by a theory developed by his former assistant, Mr. S. Sugiyama, of Japan. The primary impressed alternating m.m.f. of the current I is resolved into two component m.m.f.'s. of half intensity, revolving synchronously in opposite directions. If now a = the ratio of speed to synchronism, the two oppositely revolving components of I revolve with regard to the secondary system with the speeds $(1 - a)$ and $(1 + a)$ respectively. The same consideration applies to the secondary m.m.f. I_1, and in the secondary system we then have induction at two frequencies, $1 - a$ and $1 + a$, of which the former becomes zero at synchronism. That is, at synchronism the secondary current in the armature conductors is of double frequency, similar as in the ordinary single phase induction motor. At other speeds it is the superposition

of two currents of the frequencies $1 - a$ and $1 + a$, respectively. This theory more closely allies the repulsion motor with the ordinary induction motor. Using the same values of secondary impedance, Z_1 for both components, obviously leads to identically the same equations as given in the preceding.

The complete investigation of the repulsion motor must also take into consideration the current flowing in the armature coil during the moment where the coil is short circuited by the brushes passing from commutator segment to segment. The m.m.f. of this short circuit current of commutation is at right angles to the axis of secondary polarization of current I_1, hence has the angle of brush shaft $-(90 - \omega)$. A corrective term must, therefore, be applied, taking this phenomenon into consideration, essentially of the character of a repulsion machine with negative or generator brush angle of $(90 - \omega)$ and very high effective secondary resistance. This term is very small or negligible at speeds up to a point somewhat beyond synchronism but becomes noticeable at speeds considerably above synchronism, due to the decrease of the main current at these speeds. The main effect of this phenomenon is that the power factor of the motor instead of increasing indefinitely with the speed up to 100 per cent. at some very high speed (and then decreasing again slightly with leading current), reaches a maximum somewhere between 90 and 97 per cent., according to the constants of the motor, and then very slightly decreases with increasing speed, as is shown in the curve of the power factor of a repulsion motor in Fig. 2.

"Invention."[1]

The single word which forms the title of this article is put between quotation marks because it has been used in a similar capacity during the last few days by Mr. J. Fletcher Moulton. The occasion was the delivery of an address as President of the Junior Institution of Engineers; and it is difficult to think of a more useful subject to put before junior engineers, or of a speaker more fitted to deal with it No one has had more occasion to study the history of inventions than the great engineering K.C. It has been his business to trace the origin, development and working of many of the great mechanical processes of the age, not only in regard to their technical qualities, but also as to their financial bearings. He has brought his unrivalled store of knowledge to bear in preparing a monograph for the guidance of young men that would have cost very many times its weight in gold had it been an "opinion" prepared in the usual way.

The junior engineers have been remarkably fortunate in filling their presidential chair with men of eminence, and it is curious to speculate what would have been the cost of its presidential addresses had the time of those who have prepared them been paid for at the usual rates. That remark does not by any means apply to this Institution alone; and it is extremely gratifying to think how freely eminent men of science give their time and energy to the disinterested instruction of fellow workers. The equivalent in money would represent many thousands yearly.

Probably most engineers begin their career with golden dreams of invention; or perhaps one should say, "used to begin," because the technical colleges turn out young men preternaturally knowing, and far too learned to attempt anything, A spice of ignorance is a help to the single handed inventor. How many enterprises in life would never be undertaken if one could see the difficulties to be grappled with before success can be achieved. That is probably the reason—coupled with the fact that the layman escapes grooves—why new departures so often come from outside professional or trade circles. When one knows how very much has been done, one realizes the hopelessness of doing anything fresh.

All that applies to the single handed inventor—the man who conceives an idea and attempts, unaided, to fashion it into an invention; but the field for this class of work is daily becoming more and more restricted. Mr. Moulton, in one of the many wise apothegms contained in his address, says: "The growth of mechanical science narrows as well as widens the inventor's field." That is very true, and it may be added that the restriction is in fundamentals, whilst the widening is in detail. When Watt, who was not then an engineer, thought of the separate condenser, or Bessemer, who was not a metallurgist, conceived the idea that the carbon in molten pig iron could be burnt without extraneous fuel, they laid foundations so broad that the ground was covered, and it remained for the edifice of invention to be perfected by painstaking investigation on orthodox lines, and the application of the work of many minds. The prospect of happy thought inventions naturally contracts as time passes; indeed, to return to our simile, there can be only one foundation, but the superstructure may be raised to the height of many storys. Mr. Moulton truly says that the growth of mechanical science opens out to the inventor new possibilities; but every advance in knowledge takes from what belonged to the field of invention.

Mr. Moulton raises the question, what is an invention? and here he says the lawyers' difficulties are greatest. The benefits of the Patent Laws are confined to inventions, and it therefore becomes necessary to decide whether a new machine, or a modification of an old machine, is good subject matter for letters patent. No definition of invention has ever been fixed; and none, in Mr. Moulton's opinion, can be found which would be of the slightest assistance in a case of difficulty. "It is very much," the address adds, "like deciding whether a book belongs to literature." No one would deny it in the case of Ruskin's "Modern Painters," or assert it in the case of "Bradshaw's Guide." These are extreme cases, easy to decide; but as the dividing line is approached difficulty increases. "Some of the elements of a combination are altered so as to improve, but not essentially change its working. Is that a new invention? If it is only the substitution of mechanical elements which are notoriously the equivalents of the old elements, the law is clear; but in any other cases it is treated as being a question of fact for the judgment of whatever tribunal has the duty of deciding." It is good, therefore, to know that in this, as in many other questions, "our Courts lean to the practical rather than the dogmatic;" otherwise invention might diminish to an undesirable extent, and though some would be glad if many inventors ceased from troubling, and the manufacturer were at rest, yet such rest would be stagnation, tending to decay.

The German Patent Office inclines to a rigid test—that a new combination must produce a different technical result; whilst with us, to do the same thing better, or in a way so different that it gives the public a useful choice of means, may be sufficient to support the claim for invention. Mr. Moulton, in stating this, adds that he has little doubt that "if a case should arise in which a judicious selection, out of the list of known and notorious mechanical equivalents, gave an unforeseen and markedly superior result, the Courts would consider themselves free to hold it to be an invention." Lord Watson has said: "There are many things which you cannot say are, or are not, inventions till you have tried them."

Turning from the legal aspect of the subject, we find Mr. Moulton giving his youthful audience some excellent advice in connection with the financial or business aspect of invention. The well known Parliamentary dictum in regard to speech making—"Have something to say, say it, and sit down," he would apply to the case of sanguine inventors. They often have something to say, and they say it, but they will not then sit down. Mr. Moulton would not have them rest on their oars; but they should remember that the value and reward of an invention come when it has been made practically serviceable to mankind, and that the invention itself is but perhaps the first, and probably not the most difficult, step in the process. We remember the words of a veteran engineer, we heard many years ago, when invention seemed the high road to fortune: "To take out a patent is to acquire the right to do an infinite amount of work." Probably most young inventors think that the invention made and the patent secured, the rest is a matter of routine.

Unfortunately for themselves, and often for the world at large—but more especially for that small part of the world with which they come in contact—inventors are seldom good business men; but, more unfortunately still, they often think they are. It would seem as if it were almost a contradiction in human nature for a man to be at once ingenious, imaginative, methodical and prudent. Too often the further he can see into a mechanical problem the more restricted his vision into the industrial problem. It is not so much the lack of natural talent as that inventors can never let their inventions alone; they must always be patching and altering, pulling to pieces and building up again, striving for new effects when the old effects were good enough, so that the invention is ever in a state of flux; there is nothing solid with which to build a business. Another stumbling block in the path of the inventor is the excessive affection he has for the offspring of his brain. Philoprogenitiveness is so strong that he thinks the world can hardly continue to spin without the aid of his heaven sent inspiration. How often we hear the expression: "They must come to me, or shut up their works, when once my invention is introduced." But yet ("there being no good to hurry") the great new departure lags year after year, and still the world spins as fast and as smoothly as before.

1. *Engineering.*

Another of the inventor's enemies, allied to the first-named, is versatility. One idea leads to another, and that suggests another, until a chain is forged that stretches to a different province. The illustrious Babbage, to whom Mr. Moulton refers, was an example. A man of brilliant parts, with all the advantages education and easy circumstances could afford, he travelled from one subject to another, and died with the greater part of his life's work so incomplete that it could be brought to no useful end after his death. That, Mr. Moulton says—and few, if any, could speak with fuller knowledge—is the most common fault of inventors. "They have not the patience to develop their inventions to the stage of practical reliability, and they leave them useless, except to testify to the ingenuity of the mind that devised them." To many, it may be added, that seems sufficient recompense. Inventors often work chiefly for fame, although, in the end, they are seldom content with so simple a reward.

We have referred to the inventor who works single handed, the old-time "ingenious mechanic," or the more advanced man of scientific attainments, striving to turn knowledge to useful ends. As industries become more complex, that class has less and less chance. Combination is needed, longer experiment, a gathering together of the threads of thought proceeding from many minds. Apparatus, too, becomes more costly as it is more highly organized. All these things need wealth not often commanded by individuals; but beyond this a powerful organization is required to break down existing interests and prejudice before the invention can be transformed into a marketable thing.

"Unvarying repetition is the key to commercial production," Mr. Moulton remarks, "and the inventive genius yearns for change. * * * The strongest and most successful combinations are those in which both elements are represented in different individuals, the more practical being dominant." In this matter, we are told, we are far behind our great rivals—Germany and the United States. In the former country we see this more plainly in the chemical industry. The one hundred research chemists of one large company have been often spoken of lately; and one of the most striking examples that could be brought forward is that of the development of the catalytic, or contact, process for the manufacture of sulphuric acid. This process was invented by an Englishman about 70 years ago, but, in spite of frequent attempts to work it commercially, remained an industrial failure until taken up by one of the great German manufacturing companies. By the research department of this firm it was perfected after years of strenuous labor, both in the laboratory and the works. How many trained chemists were engaged, and how much money was spent before success was achieved, is not generally known; but it may safely be said that only by a powerful organization of capital and science could the present result have been reached, and the firm in question reap a rich harvest from their enterprise and foresight.

In America, especially in the electrical industry, a similar course is followed by many engineering works, or by syndicates established for the purpose. The evolution of the linotype machine is an instance. Years were spent, and plan after plan was devised, only to be rejected, until at last success was reached, and the inventor, with those who supported him, reaped their reward. Mr. Moulton tells us that in the United States men of inventive genius are maintained as part of a business organization for the express purpose of making inventions, which, when found of practical value, are exploited on a large scale. It is by this that he explains the successful machines of to-day, "more especially those of a complex type or that form elements of a series, which are mainly of American origin." Mr. Moulton sees no reason to think we are individually inferior to Americans in inventive faculty; but, he adds, "unquestionably English capital is, as a rule, in less enterprising hands. * * * Our great business firms are inclined to put off taking up new inventions until competition has forced them to do so; and they are still less disposed to look on invention as forming an essential part of business."

It will be seen that the presidential address of the Junior Institution of Engineers contains matter that may be read with profit by those by no means juniors. Few have had more experience of inventors, and those who work inventions, than Mr. Moulton, and no one is in a better position to judge the weakness of our national procedure. It is too much the practice with us to underrate the value of invention, forgetful that it is the spring and source of all progress in the industrial arts.

THE gas rate at Binghamton, N. Y., now rules at $1.25 per 1,000 cubic feet for all purposes. The output there for 1903, as compared with 1902, shows a gain of 28 per cent.

Construction and Maintenance of Electric Current Carrying Wires.

In a paper read by Mr. A. S. Hatch, of the Detroit Electric Light Commission, at a session of the American Society of Municipal Improvements, the author said:

Wires are divided into two classes:

1. Those for telegraph, telephone and signalling purposes.
2. Those for electric light and power purposes.

These are classified as overhead and underground.

1. Two pole lines bearing the same class of wires shall not be erected in the same street, avenue or alley, nor shall two pole lines of either class be erected on the same side of any street, avenue or alley. Whenever possible, all pole lines shall be built in alleys.

2 Poles shall be set near to and within the curb and not nearer than 10 feet from any hydrant. They must be at least 5 feet in the ground for a 30-foot pole, and not less than ⅛th of their length for longer poles. Where pole lines intersect, there must be a pole used in common, when so required, unless otherwise specified in the permit.

3. All poles now standing, or hereafter erected, shall be branded or stamped with the name or initials of the company owning them. Each group of cross arms, or where necessary the support of a single wire of different ownership must be distinguished by some characteristic mark or fastening, otherwise the owner of the pole will be held responsible.

4. All poles erected in conspicuous places must be of such weight and dimensions and be painted such a color as may be approved by the Public Lighting Commission.

5. Each line of poles must run on one side of the street only, unless special permission is given to cross.

6. Cross arms must be at least 24 inches apart, strengthened by braces and designated by some characteristic mark if belonging to a company other than the one owning the poles. In Class 1, pins must be at least 12 inches apart and inside pins 28 inches; in Class 2, inside pins 30 inches; all others 14 inches. Where wires under Class 2 are taken from the main line at any angle, the outside pins must be steel or cored, or an iron guard placed between the outside pin and the end of the arm.

7. All wires must be fastened upon poles or other fixtures with glass, porcelain or other insulators approved by the Commission, stretched properly and fastened with a tie of the same kind of wire or other fastening approved by the Commission. Lines of wires at intersections must not pass through each other, but must be either above or below, preferably Class 2 above that of Class 1. Upon all poles the lowest point in the wires suspended from them shall not be less than 25 feet from the ground.

8. All wires which would naturally pass within 4 inches of any pole, building or other object must be attached to the same and insulated therefrom. All wires strung on house tops must be at least 7 feet from flat and 1 foot from the ridge of pitched roofs. The permit must be countersigned by the occupant on whose building it is desired to fasten the wires.

9. Where wires of Class 2 are trained on the same poles as Class 1 the different potentials must be at least 4 feet apart. If only one arm is needed, the two classes should be separated, one on each side of the pole. No wire can be trained on brackets or knobs. Guys must be in proportion to the strain and not smaller than No. 8 Birmingham wire gauge and all angles must be guyed, the guys insulated, and where there are more than 4 wires in the line head guys must be used.

10. Every line, pole or fixture must be kept in thorough order and repair, in conformity with these rules and regulations in every case, where possible, under the general permit for repairs (Rule 16), upon penalty of forfeiture of all permits not acted upon and a refusal to grant new permits until the rule is complied with, but no additional poles or wires can be erected under cover of repairs, nor shall any route or location be changed without a permit.

11. All wires or current carrying conductors, poles, guys or apparatus belonging to any person, firm or corporation that may be found dangerous to life or property or intruding on the rights of citizens or other corporations must be remedied by the owners thereof when notified. This applies to any damage to sewers, conduits, cables, gas or water pipes, by electrolysis or otherwise.

12. All wires of Class 2 must be secured to insulating fastenings and covered with an insulation easily abraded and waterproof, approved by the Commission. Whenever the insulation becomes impaired it must be renewed immediately.

13. All connections with pole lines for service in either class must be

made at right angles to the line where possible, and connections to buildings shall be run straight across to buildings, where possible, and then down, and the insulation must be preserved throughout the entire circuit.

14. No electrical conductor shall be erected, maintained or placed overhead or underground without a permit in writing therefor being first obtained from the Public Lighting Commission, and before such permit is issued the person, corporation or company wishing to place or maintain said wires shall make application to said Commission, in writing, stating the size of said wire, the purpose for which it is intended and the character of the current it is intended to convey; also a plan or description showing the position to be occupied and general arrangement.

15. All owners are authorized and directed to make necessary repairs to their lines of conductors, and permits for such repairs will be granted by the Commission upon application. In case of emergency repairs may be made without permit, but a report of such repairs is to be forwarded within twenty-four (24) hours after the making of the repairs and a regular permit taken out at that time.

16. Where notice has been given of underground accommodations and the notice of time required by law has elapsed, companies owning or operating overhead lines are not authorized to make any repairs or connections, or t› go upon the poles bearing such wires for any purpose whatever except to remove said lines in conformity with the direction of said Commission.

17. The amount of wire allowed for service connection from a pole to a building shall not exceed 130 feet between supports, except by special permit.

18. The person, firm or corporation owning or controlling poles in any street, alley or public place in the city of Detroit must allow the same to be used by other persons, firms or corporations operating wires, cables or conductors for electrical service when authorized to do so by the Commission on tender of proper compensation to be determined by agreement between the parties interested. If the present capacity is not sufficient for both lines and unless otherwise agreed upon between them the party desiring accommodation may rebuild the line of poles and rent contracts to the owners of the previously existing lines at terms to be agreed upon between the parties. In default of any agreement between the parties interested, the matter may be referred to the Public Lighting Commission for arbitration and their decision is to be final.

19. Any person, firm or corporation in accepting any permit from the Public Lighting Commission hereby binds himself or themselves to the acceptance of any provisions specified in any rule established or to be established by the Commission, unless it is specifically excepted in the permit. The Public Lighting Commission reserves the right to alter or add to these rules as it may desire at any time.

20. It shall be the duty of the Public Lighting Commission to turn all money received under this ordinance into the Public Lighting fund of the city of Detroit.

21. No person, firm or corporation shall train wires, erect poles, build conduits, manholes, hand holes or make any alterations whatever in electric line equipments without first notifying this Commission in writing giving a description with diagram of the proposed work, allowing ample opportunity for inspection, and receiving from said Commission a written permit to do the work described. All such work, equipment, alteration or addition shall be done under the supervision of and subject to the inspection of said Commission. Upon finding the work to be done according to such rules and regulations, the Commission shall certify and place the record thereof on its books, maps, cards or diagrams, but no such equipment shall be used by anyone until such certificate shall have been given by said Commission in conformity therewith.

22. Any firm or corporation who shall make contact to poles or other property of the Public Lighting Commission, Police or Fire Commissions without having obtained a permit for the same from the Public Lighting Commission shall pay a fine of $3 for each such unauthorized contact and no further permits shall be granted to said person, firm or corporation until the aforesaid fine or fines are paid.

23. Owners of lines of poles or of buildings shall remove therefrom all dead wire or wires fastened thereto in violation of these rules, when notified to do so by the Public Lighting Commission within a reasonable time to be expressed in the notice; on failure to do so the Public Lighting Commission will proceed to remove the same.

Many details can be added to these rules, if necessary to fit local conditions.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

ACCORDING to the New York *Sun*, Mayor McClellan's bill for the regulation of trading and dealing in gas in New York city, which is now before the State Legislature, is about like this: "The bill was prepared by Corporation Counsel Delaney, and Senator Foley will introduce it in the Senate and Assemblyman Miller will present it in the Lower House. It consists of two amendments to the charter of the city of New York. The first section amends Sec. 519 of the charter, which deals with the powers of the Commissioner of Water Supply, Gas and Electricity. It extends the supervision now exercised by the Commissioner over electric meters so as to include gas meters as well. Under its terms the Commissioner is to cause tests to be made of all meters in use in the city for measuring the quantity of gas, as well as electricity or steam, furnished by any corporation or person. It provides that thereafter no corporation or person shall furnish or put in use any gas, electric or steam meter which shall not have been inspected, approved and sealed by inspectors appointed by the Commissioner. Every gas company must keep on its premises proper apparatus for testing and proving the accuracy of meters furnished by it for use. Whenever a meter has been inspected the inspector shall attach thereto a seal or stamp with his name, the date of the inspection and a statement as to whether or not the meter is accurate. The Commissioner of Water Supply, Gas and Electricity is to cause every gas meter in use or intended to be used to be tested at least once in every year, and an accurate and detailed report of the condition of each meter is to be kept as part of the records of the department. Whenever a meter is found defective the Commissioner must order it removed and replaced by one which has been attested and approved. Meters in use are to be reinspected and tested on the written request of the consumer or of the company, in the presence of the consumer if desired. If the meter is found defective to the prejudice or injury of the consumer, the removal, inspection and replacing of the meter shall be without expense to the consumer, but in all other cases, except where the change is beneficial to the company, he shall pay the reasonable expense of the inspection. An amendment to this section permits the inspectors of the Department of Water Supply, Gas and Electricity at all reasonable times, on exhibiting written authority from the Commissioner, to enter any dwellings, store or building lighted with gas for the purpose of inspecting the meter, pipes, fittings and works and the quality of the gas supplied, and any person who hinders such inspector shall be guilty of a misdemeanor. The Commissioner may adopt such rules and regulations and may direct and compel the use of such meter or other mechanical device as in his judgment may be necessary for the purpose of recording the quantity of gas consumed and controlling and regulating the pressure of gas or other substance into the pipes or other apparatus used in the distribution of gas. It will be the duty of every person or corporation supplying gas to consumers to comply with such rules, and a failure to do so is made a misdemeanor. The second section of the bill amends Sec. 522 of the charter, under which the Commissioner of Water Supply, Gas and Electricity now tests the quality of gas. It strikes out the restriction that the Commissioner may not inspect the gas oftener than once a week, and permits him to make tests as often as may be necessary. It eliminates also the requirement that three consecutive tests must show an illuminating power less than the standard before a fine may be imposed, and makes it the duty of the Commissioner to impose a fine whenever such a test shows that the gas is below the standard. The amount of the fine is raised by the amendment from $100 to $500. It is provided that an accurate record of all such tests shall be filed with the Department of Water Supply, Gas and Electricity. As an auxiliary to this bill the Corporation Counsel has drawn an amendment to Article VI. of the Transportation Corporations law, by which all the powers now exercised by the State Inspector of Gas Meters are conveyed to the Commissioner of Water Supply, Gas and Electricity in the city of New York. This bill also will be introduced in the Legislature this week. The Mayor said that while it was not in his province to suggest measures to the Legislature, he hoped to meet Governor Odell in a spirit of co-operation. He felt confident that the bill would have the support of the Democratic members from the city of New York and hoped that a majority in the Legislature would look on it with favor."

THE corporate title of the Humphrey Mfg. and Plating Company, of Kalamazoo, Mich., has been changed to that of the Humphrey Company. The address remains the same.

WRITE to the C. W. Hunt Company, of West New Brighton, N. Y., for a copy of its "Industrial" Railway Catalogue. In it will be found

descriptions, well illustrated, of many things that go to complete a finished gas works.

A WELL-KNOWN gas man who has to do with the external business of the York (Pa.) Gas Company, incloses a copy of the York *Gas Herald*, dated the 25th inst., the columns of which hold the following invitation to the pupils of the schools of the city from whence the paper derives its name: "The boys and girls who attend the public or private schools of York are invited to write essays or newspaper articles suitable for publication in the *Gas Herald* in competition for cash prizes as follows: $10 for the best article; $5 for the second best; $2.50 for the third best. All other articles accepted for publication will be paid for at 50 cents each at time of publication. Those who desire to contribute must be governed by the following conditions:

"1. (a) cooking with gas; (b) the gas range; (c) our gas range; (d) gas vs. coal for cooking; (e) practical uses to which gas may be put and their advantages.

"2. Do not write less than 200 words nor more than 500. Write on one side of the paper only.

"3. Your name must not appear in or at the end of your article. Write your name and address upon a separate piece of paper or a card, and inclose in a blank envelope, sealing same securely. Inclose the sealed envelope with your article in another envelope and mail to *Gas Herald*, Gas Office, York, Pa. When your article is received we will give it a number and place the same number on the accompanying envelope. After the articles are examined and the winning ones selected, the envelopes bearing the number of the articles will be opened and the awards made.

"4. The contest will close Thursday, February 25, 1904. All articles must be in on or before that date.

"5. Any boy or girl who is attending any school, high, grammar, college, academy, business, parochial or others, may send in an article. The subject matter may treat of actual experiences in the homes of those who use gas, or the results of investigation on the part of those who do not use gas. Get information from: Mother, father, the cook, and from friends and neighbors. Competent and disinterested judges will select the winning articles without knowing who the writers are. Be sure to follow instructions contained in second condition. Results of the contest will be published in the March issue of the *Herald*." Also in the A. G. L. J.

AT the annual meeting of the shareholders in the St. Paul (Minn.) Gas Light Company the officers elected were: Directors, F. M. Auerbach, E. A. Young, G. H. Prince, Crawford Livingston and Emerson McMillin; President, A. P. Lathrop; Vice-President, Kenneth Clark; Secretary and Treasurer, J. P. Crowley.

At the annual meeting of the United Gas and Electric Company's shareholders, the headquarters of which are in San Francisco, Cal., the following officers were elected: C. E. Green, W. Gregg, Jr., R. J. Davis, C. H. Pennoyer and J. E. Green; President, J. E. Green; Vice-Presidenr, C. E. Green; Secretary, C. H. Pennoyer; Assistant Secretary, E. B. Lilles.

THE Kewanee (Ills.) Light and Power Company has agreed to expend $50,000 on its gas plant this season. At least its shareholders have authorized such expenditure. Mr. Xenophon Caverno will have charge of the reconstruction.

THE Fall River (Mass.) Gas Company has decided to move its office quarters to the Bennett building, the completion of which is announced for the 1st prox. It will have the handsomest offices of any ordinary corporation in Fall River, the main service room or customers' quarters being located on the ground floor.

MR. J. MURRAY HOWE has been appointed by the Board of Gas and Electric Light Commissioners of Massachusetts as the real estate expert who is to value such matter on account of the proposed consolidation of the various Boston Gas Companies.

AT the annual meeting of the New Britain (Conn.) Gas Light Company the officers elected were: Directors, A. J. Sloper, H. E. Russell, G. M. Landers, E. N. Stanley, John Walsh and F. M. Travis; President, A. J. Sloper; Treasurer and Secretary, H. T. Sloper. Messrs. Walsh and Travis are new members on the Board, the number of which was ordered changed by a by-law from 4 to 6.

THE East Boston (Mass.) Gas Company has declared the usual semi-annual dividend of 3 per cent., payable on demand.

THE gas and electric lighting plants of Salisbury, N. C., have been sold to those interested in the propagation and maintenance of the Salisbury-Spencer Light and Railway Company.

MR. CHARLES A. TUCKER has been appointed Treasurer of the Laclede Gas Light Company, of St. Louis, Mo. He was formerly in the service of the New Haven (Conn.) Gas Light Company.

MR. J. R. HUNTING, formerly in the service of the Denver (Col.) Gas and Electric Company, has been appointed Manager of the new business department of the Lincoln (Neb.) Gas and Electric Company.

MR. JAMES DONOVAN, Acting Superintendent of Lamps for Boston, Mass., in his report respecting the operations of his department for the year 1902, among other things says: "Mr. John Drohan, who was appointed Superintendent of the Department for the term ending May 1, 1903, died on Saturday, August 9, 1902, and the present Acting Superintendent assumed charge of the Department from that date. The amount appropriated for this Department for the financial year ending on January 31, 1903, was $775,000, and there was expended $772,079.16, leaving a balance of $2,920.84, which was transferred to other departments. In order to keep within the sum appropriated by the City Council for this Department, it became necessary from time to time to temporarily discontinue lighting 426 arc lamps in various sections of the city. These lamps were located principally upon the parks and parkways, and upon such streets where after inspection it was considered that they might be temporarily dispensed with and at the same time not cause too much inconvenience to the public. A portion of these lamps are still cut out. The amount paid for lighting the electric, gas, and naphtha lamps in 1902, as compared with that of 1901, is shown as follows:

	1902.	1901.
Paid for electric lamps.....	$423,837.19	$431,357.09
Paid for gas lamps	273,239.48	264,454.11
Paid for naphtha lamps.....	54,625.81	55,603.83

An increase of $8,785.37 for gas lamps, a decrease of $7,519.90 for electric lamps, and a decrease of $978.02 for naphtha lamps. The number of new lamps installed has of necessity been small, and only such underground work that has been absolutely required has been attended to. There have been installed during the year 267 new lamps of all kinds, and 26 lamps have been replaced.

"The new gas lamps erected have been located principally in Roxbury, Dorchester, West Roxbury, and Brighton; the new common naphtha lamps in West Roxbury; the new Welsbach naphtha lamps in West Roxbury and Dorchester; the new arc lamps in Brighton, City Proper and Roxbury, and all of the new Kitson lamps in Dorchester. The lighting with incandescent lamps of the Traverse street subway, between Canal and Haverhill streets, has been assumed by this Department, also the lighting of the steps leading from Brooks street to Faneuil station, Brighton. Gas lamps have been substituted for naphtha lamps where the gas mains have been extended in Dorchester, West Roxbury, South Boston, Roxbury, Brighton, and East Boston, to the number of 94. Forty-nine common naphtha lamps in West Roxbury, 28 in South Boston and 26 in Dorchester have been changed to Welsbach naphtha lamps. The locations of 26 gas lamps, of 65 naphtha lamps, 28 arc lamps and 1 Kitson lamp, also 4 gas brackets, have been changed by reason of building alterations, street changes, or for the better lighting of the streets. Thirty-eight gas and 44 naphtha lamp posts have been straightened; 115 gas, 34 naphtha, and 9 arc lamp posts have been reset to line and grade; 105 gas, 19 naphtha, 46 arc, and 1 fire alarm lamp posts have been removed from the streets; also, 27 gas and 3 naphtha brackets have been removed from the walls of buildings. Two hundred and forty-two posts have been set for the new gas, naphtha, arc and Kitson lamps; 17 posts have been set in place of broken ones, and 21 posts have been set in place of brackets. The locations of 138 lamps of all kinds have been abandoned and the lamps removed. Two hundred and eight gas services have been relaid or repaired; 18 services have been reconnected with new mains; 170 services have been removed and cut off at the main; 234 new services have been laid and many services that have become obstructed from various causes have been cleared.

"At present there are 9,124 Welsbach gas lamps in use, paid for at the rate of $30 per lamp per annum. The contractor furnishes Welsbach boulevard lanterns, burners, mantles and gas—also the lamplighters; and the city provides for the setting of the lamp posts and has service pipes laid from the gas main to the top of the lamp posts. The public lamps are burned every night throughout the year; a total of 3,828 hours for each lamp."

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, FEBRUARY 15, 1904.

The Market for Gas Securities.

The net result of the trading in Consolidated for the week was a gain of a point, and that was registered at the close to-day (Thursday), the last sale having been made at 191. Transactions were on a very heavy scale, the tally sheets showing the disposal of 34,002 shares. People in the market have finally analyzed the provisions of the proposed amendments to the laws relating to the sale of gas in New York. Brooklyn Union is dull and unchanged.

The outside market is very uneven. Of course, the terrible calamity at Baltimore puts figures on Consolidated of that city out of the reckoning, and he indeed would be a wise one who could figure its loss since the main point therein must refer to output losses that will last for perhaps 2 years. Peoples, of Chicago, is at the figures of last week. Massachusetts gas, preferred, is 80 bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEBRUARY 15.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	189¾	192
Central Union, Bonds, 5's	3,000,000	1,000	104	106
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000	..	108	112
Mutual	3,500,000	100	260	290
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	103	105
Northern Union, Bonds, 5's.	1,250,000	1,000	105	106½
New York and East River ..				
Bonds 1st 5's	3,500,000	1,000	102	106
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	125	135
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	185	195
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	3/16	¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works....	450,000	100	28	80
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust....	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4½	4½
" " Bonds, 5's	5,250,000	1,000	65	69
Capital, Sacramento..	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104½
Cincinnati Gas and Electric Co.	29,500,000	100	97¾	98
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89½
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore...	11,000,000	100	—	—
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's....	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
Con. Mtg. 5's	980,000	1,000	86	90
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's....	982,000	1,000	75	75½
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	55	65
" Bonds, 6's	2,650,000	..	103½	106½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	79	90
Preferred	2,500,000	100	100	105
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	64	70
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	99¼	100
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	.
Rochester Gas & Elec. Co..	2,150,000	50	58	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	..	55
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	92	96¼
St. Paul Gas Light Co	1,500,000	100	4	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's..	2,465,000	1,000	92	94
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047,000	1,000	94	96
Washington, D. C	2,600,000	20	277½	278½
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	.	..	..
Wilmington, Del	600,000	50	230	..

Advertisers' Index.

GAS ENGINEERS. Page

A. E. Boardman, New York City ... 272
Baxter & Young, Detroit, Mich ... 272
B. E. Chollar, St. Louis, Mo ... 258
David Leavitt Hough, New York City ... 272
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Frank D. Moses, Trenton, N. J ... 258
Fred. Bredel Co., Milwaukee, Wis ... 260
Frederic Egner, Washington, D. C ... 256
Geo. R. Rowland, New York City ... 262
Humphreys & Glasgow, New York City ... 273
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 272
The Gas Machinery Co., Cleveland, O ... 259
The Jeffrey Manufacturing Co., Columbus, O ... 270
The Western Gas Construction Co., Fort Wayne, Ind. ... 240
United Gas Improvement Co., Philadelphia, Pa. ... 267
Wm. Henry White, New York City ... 275

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City ... 272
Bartlett, Hayward & Co., Baltimore, Md ... 273
Baxter & Young, Detroit, Mich ... 272
Connelly Iron Sponge and Governor Co., New York City 223
Continental Iron Works, Brooklyn, N. Y ... 274
Cruse-Kemper Co., Philadelphia, Pa ... 259
Davis and Farnum Mfg. Co., Waltham, Mass ... 272
Deily & Fowler, Philadelphia, Pa ... 276
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Frank D. Moses, Trenton, N. J ... 258
Fred. Bredel Co., Milwaukee, Wis ... 260
G. Shepard Page's Sons, New York City ... 272
Humphreys & Glasgow, New York City ... 273
Isbell-Porter Company, New York City ... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 272
Lloyd Construction Co., Detroit, Mich ... 262
Logan Iron Works, Brooklyn, N. Y ... 276
Quintard Iron Works, New York City ... 273
R. D. Wood & Co., Philadelphia, Pa ... 274
Riter-Conley Mfg. Co., Pittsburg, Pa ... 275
Stacey Mfg. Co., Cincinnati, O ... 275
The Connersville Blower Company, Connersville, Ind. .. 277
The Gas Machinery Co., Cleveland, O ... 259
The Jeffrey Manufacturing Co., Columbus, O ... 270
The Western Gas Construction Co., Fort Wayne, Ind. ... 240
United Gas Improvement Co., Philadelphia, Pa ... 267

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 273
B. E. Chollar, St. Louis, Mo ... 258
Economical Gas Apparatus Construct'n Co, Toronto, Ont 264
Fred. Bredel Co., Milwaukee, Wis. ... 260
Humphreys & Glasgow, New York City ... 273
The Gas Machinery Co., Cleveland, O ... 259
The Western Gas Construction Co., Fort Wayne, Ind. ... 240
United Gas Improvement Co., Philadelphia, Pa ... 267

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N. Y ... 274
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis ... 260
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 272
Logan Iron Works, Brooklyn, N. Y ... 276
R. D. Wood & Co., Philadelphia, Pa ... 274
Riter-Conley Mfg. Co., Pittsburg, Pa ... 275
Stacey Mfg. Co., Cincinnati, O ... 275
The Gas Machinery Co., Cleveland, O ... 259
The Western Gas Construction Co., Fort Wayne, Ind. ... 240

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
R. D. Wood & Co., Philadelphia, Pa ... 274

TAR AND CARBONIC ACID EXTRACTOR.

Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis ... 260
Stacey Mfg. Co., Cincinnati, O ... 275
The Gas Machinery Co., Cleveland, O ... 259
The Western Gas Construction Co., Fort Wayne, Ind. ... 240

AMMONIA CONCENTRATORS.

Fred. Bredel Co., Milwaukee, Wis ... 260
Michigan Ammonia Works, Detroit, Mich ... 260
The Gas Machinery Co., Cleveland, O ... 259
The Western Gas Construction Co., Fort Wayne, Ind. ... 240

GAS METERS.

American Meter Co., New York and Philadelphia..... 279
Detroit Meter Company, Detroit, Mich..... 239
D. McDonald & Co., Albany, N.Y..... 277
Helme & McIlhenny, Philadelphia, Pa..... 279
John J. Griffin & Co., Philadelphia, Pa..... 280
Keystone Meter Co., Royersford, Pa..... 278
Maryland Meter and Mfg. Co., Baltimore, Md..... 278
Metric Metal Co., Erie, Pa..... 279
Nathaniel Tufts Meter Co., Boston, Mass..... 278

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 279
D. McDonald & Co., Albany, N. Y..... 277
Helme & McIlhenny, Philadelphia, Pa..... 279
John J. Griffin & Co., Philadelphia, Pa..... 280
Keystone Meter Co., Royersford, Pa..... 278
Nathaniel Tufts Meter Co., Boston, Mass..... 278

PREPAYMENT METER ATTACHMENTS.

Reeves Mfg. Co., New Haven, Conn..... 260

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Donaldson Iron Co., Emaus, Pa..... 264
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
M. J Drummond & Co., New York City..... 264
R. D. Wood & Co., Philadelphia, Pa..... 274
Warren Foundry and Machine Co., New York City..... 264

NON-RUSTING PIPE LUBRICANT.

Alan H. Tripp, Chicago, Ills..... 260

GAS COALS.

Berwind White Coal Mining Co., New York and Phila. 270
Perkins & Co., New York City..... 270
Westmoreland Coal Co., Philadelphia, Pa..... 271

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa..... 261

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N.Y. City..... 264

GAS TAPPING MACHINES.

George Light, Dayton, O..... 264
H. Mueller Manufacturing Company, Decatur, Ills..... 261

CANNEL COALS.

Perkins & Co., New York City..... 270

STOKING MACHINERY.

G. A. Bronder, New York City..... 269

CONVEYORS.

Adam Weber Sons, New York City..... 268
C. W. Hunt Company, New York City..... 261
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Fred. Bredel Co., Milwaukee, Wis..... 260
G. A. Bronder, New York City..... 269
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
The Brown Hoisting Machinery Co., Cleveland, O..... 256
The Gas Machinery Co., Cleveland, O..... 269
The Jeffrey Manufacturing Co., Columbus, O..... 270
The Link-Belt Engineering Co., Philadelphia, Pa..... 256
The Link-Belt Machinery Co., Chicago, Ills..... 264
The Western Gas Construction Co., Fort Wayne, Ind... 240

CHARGING BARROWS & COAL WAGONS.

Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Stacey Mfg. Co., Cincinnati, O..... 275

GAS ENRICHERS.

Standard Oil Co., New York City..... 231
Sun Company, Pittsburg, Pa..... 271
The Sun Oil Co., Pittsburg, Pa..... 271

COKE CRUSHERS.

C. M. Keller, Columbus, Ind..... 271
Fred. Bredel Co., Milwaukee, Wis..... 260
The Jeffrey Manufacturing Co., Columbus, O..... 270

STEAM BLOWER FOR BURNING BREEZE.

The Connersville Blower Company, Connersville, Ind... 277

ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N.Y..... 262

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 262

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 223
Fred. Bredel Co., Milwaukee, Wis..... 260
Isbell-Porter Co., Newark, N. J..... 274
R. D. Wood & Co., Philadelphia, Pa..... 274

CEMENTS.

C. L. Gerould, Galesburg, Ills..... 268

RETORTS AND FIREBRICKS.

Adam Weber Sons, New York City..... 268
Baltimore Retort and Firebrick Co., Baltimore, Md..... 268
Brooklyn Firebrick Works, Brooklyn, N. Y..... 268
Henry Maurer & Son, New York City..... 268
James Gardner, Jr., Co., Pittsburg, Pa..... 268
J. H. Gautier & Co., Jersey City, N. J..... 268
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 268
Missouri Firebrick Co., St. Louis, Mo..... 268
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258
The Kreischer Brick Mfg. Co., New York City..... 268

INCLINED RETORTS.

Adam Weber Sons (Graham, Morton [England] System) 268
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 223
Fred. Bredel Co., Milwaukee, Wis..... 260
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258

VERTICAL S'S.

Adam Weber Sons (Oscar B. Weber's Construction)..... 268
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 223
Fred. Bredel Co., Milwaukee, Wis..... 260
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258

REGENERATIVE FURNACES.

Adam Weber Sons, New York City..... 268
Bartlett, Hayward & Co., Baltimore, Md..... 274
Fred. Bredel Co., Milwaukee, Wis..... 260
J. H. Gautier & Co., Jersey City, N. J..... 268
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 268
Missouri Firebrick Co., St. Louis, Mo..... 268
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 258

SELF-SEALING MOUTHPIECE DOORS.

Continental Iron Works, Brooklyn, N.Y..... 274
Fred. Bredel Co., Milwaukee, Wis..... 270
Isbell-Porter Co., Newark, N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Logan Iron Works, Brooklyn, N.Y..... 276
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The Gas Machinery Co., Cleveland, O..... 259
The Western Gas Construction Co., Fort Wayne, Ind... 240

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City..... 268

INCANDESCENT GAS LAMPS.

Ball Check Light Co., New York City..... 258
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 260
General Gas Light Co., Kalamazoo, Mich..... 259
Lindsay & Co., Chicago, Ills..... 257
Welsbach Company, Gloucester, N. J..... 266

BURNERS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 260
Wm. M. Crane Co., New York City..... 261

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 260

STREET LAMPS.

Thos. T. W. Miner, New York City..... 261
Welsbach Street Lighting Co., New York and Phila.... 266

PURIFIERS.

Connelly Iron Sponge and Governor Co., New York City. 223
Fred. Bredel Co., Milwaukee, Wis..... 260
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The Western Gas Construction Co., Fort Wayne, Ind... 240

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 223

(*Continued on page 256.*)

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AS MANAGER

Of gas, or gas and electric light plant, by a man who can show first-class results in former positions. South or Southwest preferred.
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(*Continued from page 255.*)

VALVES.

Continental Iron Works, Brooklyn, N. Y..... 274
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Isbell-Porter Co., Newark, N. J..... 274
Kerr Murray Mfg. Co., Fort Wayne, Ind 272
Ludlow Valve Manufacturing Co., Troy, N.Y..... 261
R. D. Wood & Co., Philadelphia, Pa..... 274
Stacey Mfg. Co., Cincinnati, O..... 275
The P. H. & F. M. Roots Co., Connersville, Ind..... 263
The Western Gas Construction Co., Fort Wayne, Ind.... 240

EXHAUSTERS.

Connelly Iron Sponge and Governor Co., New York City 228
Isbell-Porter Company, Newark, N. J 274
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
The Connersville Blower Company, Connersville, Ind... 273
The P. H. & F. M. Roots Co., Connersville, Ind..... 263

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 275

PURIFIER SCREENS.

John Cabot, Hoboken, N. J..... 260

GAS STOVES.

Abendroth Brothers, New York City..... 260
American Meter Co., New York and Philadelphia..... 265
American Stove Co., Cleveland, O 256
Detroit Stove Works, Detroit and Chicago..... 278
Keystone Meter Co., Royersford, Pa..... 278
Maryland Meter and Manufacturing Co., Baltimore, Md. 278
Nathaniel Tufts Meter Co., Boston, Mass..... 278

HOT WATER HEATERS.

Abendroth Brothers, New York City..... 260
Humphrey Co., Kalamazoo, Mich..... 264

GASHOLDER TANKS.

J. P. Whittier, Brooklyn. N.Y..... 262

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 273
Continental Iron Works, Brooklyn, N.Y..... 274
Cruse-Kemper Co., Philadelphia, Pa. 259
Davis & Farnum Mfg. Co., Waltham, Mass..... 272
Deily & Fowler, Philadelphia, Pa..... 276
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 264
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 272
Logan Iron Works, Brooklyn, N Y..... 276
R. D. Wood & Co., Philadelphia, Pa..... 274
Riter-Conley Mfg. Co., Pittsburg, Pa..... 275
Stacey Mfg. Co., Cincinnati, O..... 275

STORAGE TANKS.

Stacey Mfg. Co., Cincinnati, O..... 275

PAINTS.

National Paint Works, New York City..... 272

PATENTS, TRADE-MARKS, COPYRIGHTS.

Royal E. Burnham, Washington, D. C..... 260

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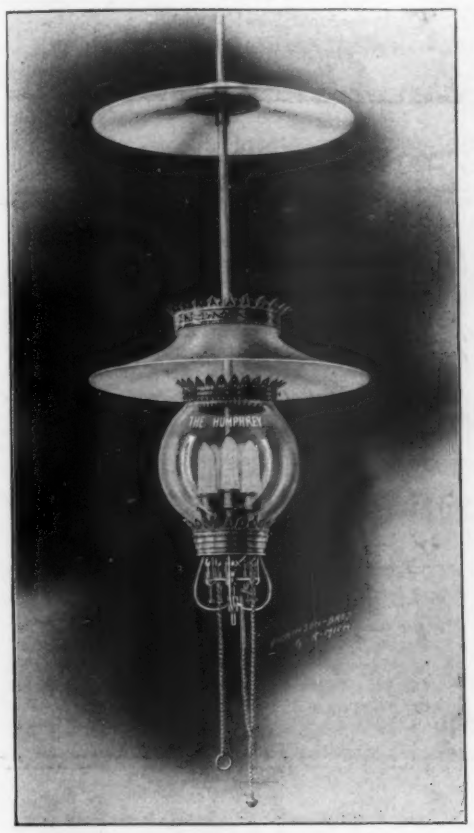

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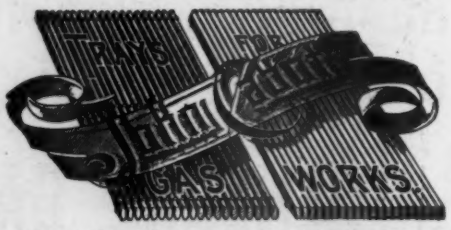

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An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 34th year of publication. Compiled and arranged by JOHN W. FIELD, Sec'y and Gen. Mgr. of The Gas Light and Coke Company, London. Price, $5. For Sale by

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These are the only Acetylene Burners which can be turned high or low without carbonizing, and, therefore, they remove one of the greatest barriers to the progress of lighting by Acetylene. Write for further information.

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SOLE AGENTS FOR THE UNITED STATES,

1131 Broadway, New York.

Gas Coke Car, with water spray attachment to prevent car from becoming red hot.

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We keep in stock a large supply of

Charging Cars,
Coke Cars,
Self Dumping Cars,
Tip Cars.

Write for Catalogue 030, which contains a special offer, whereby a trial test of this system of narrow gauge railway can be made without charge, excepting a few dollars for freightage.

Everything for use with the "Industrial" Railway kept in stock for prompt delivery.

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Mueller Gas Cocks.

B—755.

TOO little is not as much as you pay for, and too much is more paid for than you need.

In **Mueller Gas Cocks** you find a happy medium--not so little metal as to leave them weak, nor yet so much as to make them costly.

Made in 145 styles, seven sizes in each style.

MADE ONLY BY

H. MUELLER MFG. CO.,

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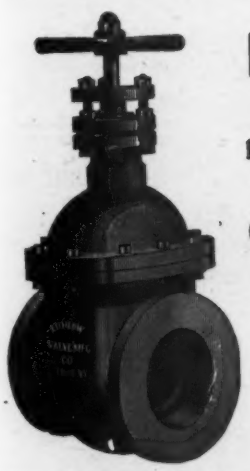
TROY, N. Y., U. S. A.

Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.



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Globe Street and Boulevard Lamps.

Cheapest and Best.

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Send for Catalogues.

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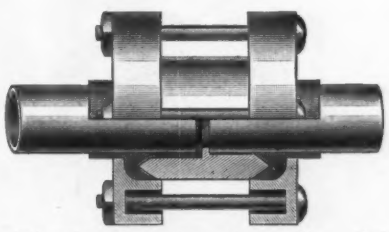
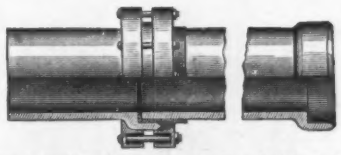
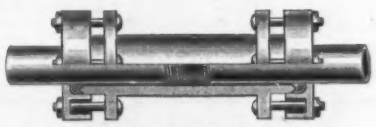


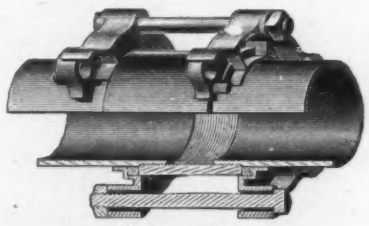
Insulating Coupling for Wrought Iron Pipe. Style 5.



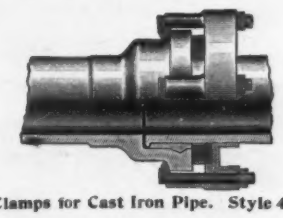
Insulating Coupling for Dresser Bell and Spigot Cast Iron Pipe. Style 6.



Regular Sleeve. Style 2.



Clamp. Style 4.



Clamps for Cast Iron Pipe. Style 4½.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pipe by electrolytic action, in either water or gas lines.

SEND FOR CATALOGUE.

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GAS WORKS BUILDERS.

Economize Heat in Water Gas Plants,

BY UTILIZING A

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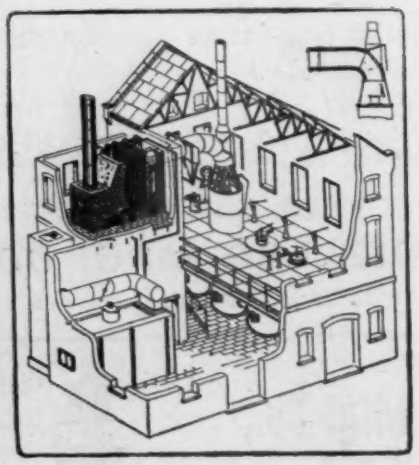

To absorb the heat now going to waste when you blow through your superheater to heat the feed water for your boilers to the temperature of the steam. This is now being done at the Poughkeepsie Gas Works, Poughkeepsie, N. Y. : : : : :

Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

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Plans prepared and Estimates furnished at short notice.

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Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

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PRESSURE GAUGE.

For continuous records of **Street Gas Pressure.** Simple in construction, accurate in operation and low in price.

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Silver Medal, Paris Exposition.

Gas Analyses of All Sorts and Conditions,
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Analyses of Solid and Liquid Materials as Well,

That are needed by Gas Companies at any time in the conduct of their business, may be obtained from

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Gas Engineer's Pocket-book, —BY— HENRY O'CONNOR.
Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works. **PRICE, $3.50.** For Sale by
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Occupies this Space Every Alternate Week.

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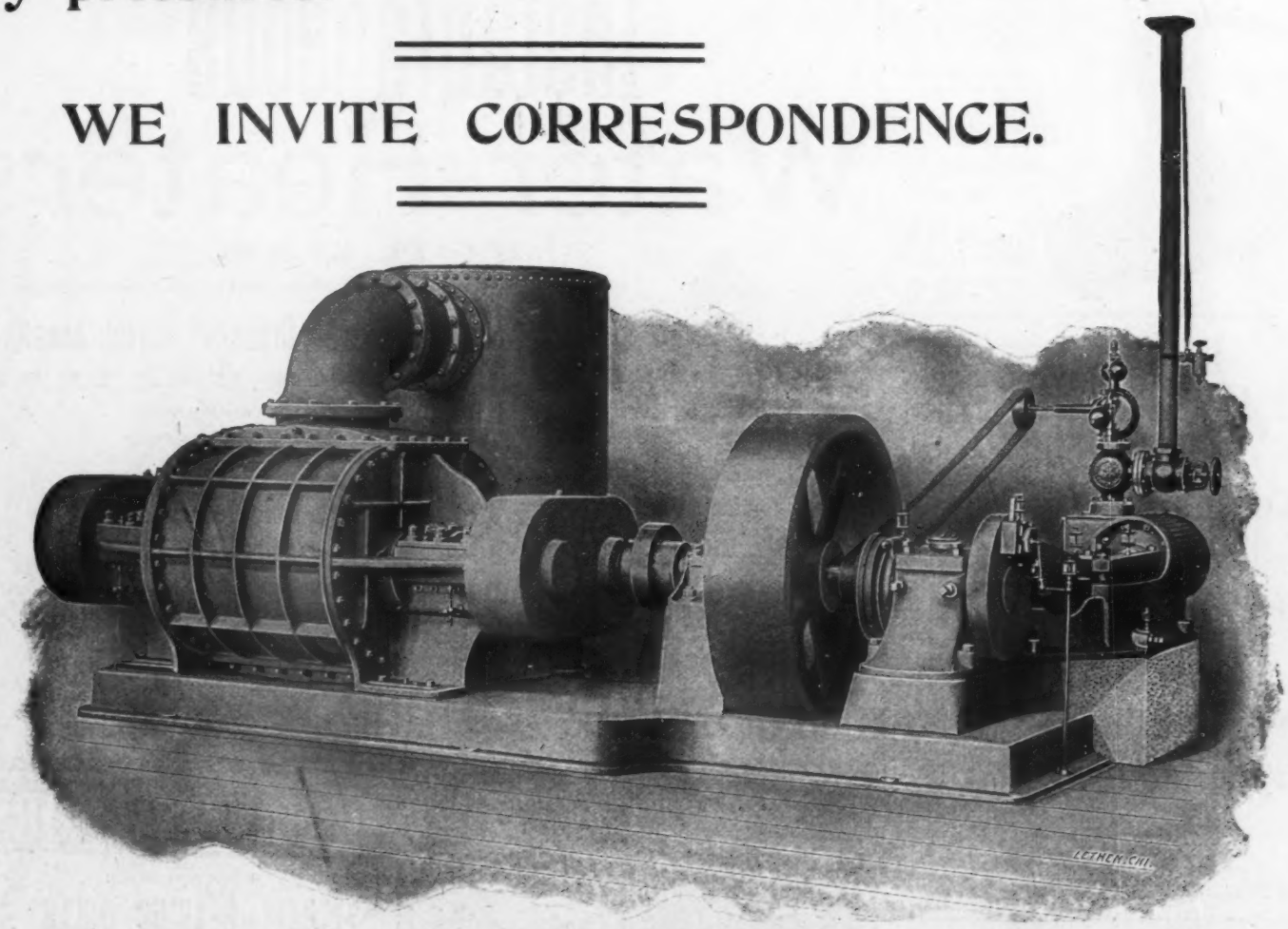
HORIZONTAL GAS EXHAUSTER.

WE are building a line of Exhausters as per cut herewith, for forcing gas long distances and under pressures that are higher than ordinary pressures.

WE INVITE CORRESPONDENCE.



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"Elbow Specials Quick Etc." "Elbowgrease" Pipe Fitters

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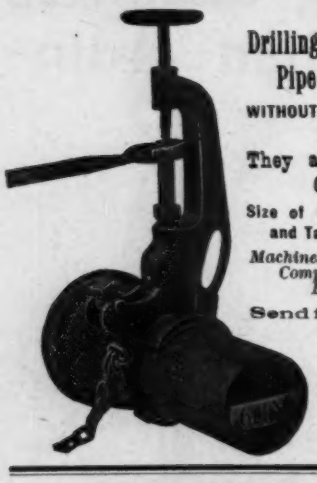
GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.



They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

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THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

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Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

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Valuation of Gas, Electricity and Water Works

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

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SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :

Temporarily during alterations and repairs. : : : :

STOPPERS SENT ON TRIAL.

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Instantaneous

Water Heaters

FOR GAS.

With our experience, ability and facilities we produce

Humphrey Crescent Instantaneous

WATER HEATERS.

Simple construction.
Perfect workmanship.
Highest efficiency.
Prices surprisingly low.

No. 2, Price, $35.

GUARANTEED.

For general use and long continued satisfaction, we recommend this No. 2 Heater, the handsomest ever made.

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BELT CONVEYORS

EQUIPPED WITH

BALL BEARING ROLLS

ARE THE BEST,

because they possess greater efficiency, consume less power, and the belts last longer than when any other type of roll is employed.

PLANS AND ESTIMATES FURNISHED ON REQUEST.

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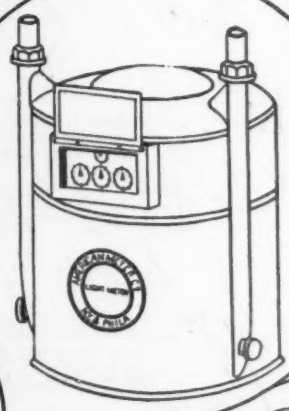
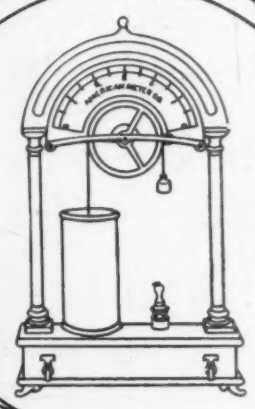
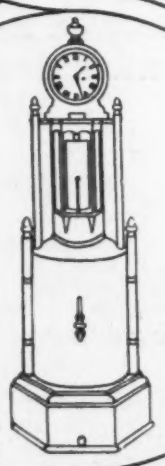


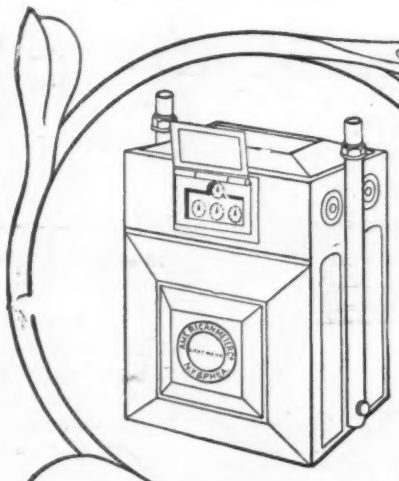


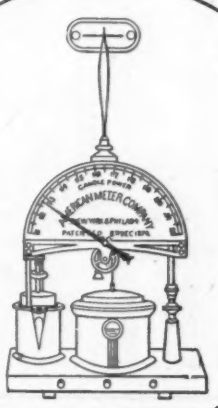


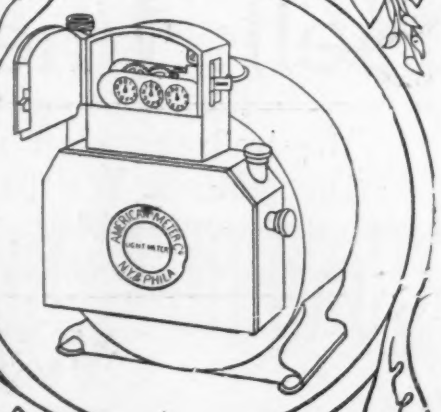
PUBLIC LIGHTING TABLE.

MARCH, 1904.

DAY OF WEEK.	DATE.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish
				P.M	A.M
Tue.	1	No L FM	No L.	5 30	5.4
Wed.	2	No L.	No L	5.30	5.4
Thu.	3	6.20 PM	9.00 PM	5.30	5.4
Fri.	4	6.20	10.10	5.30	5.4
Sat.	5	6.20	11.20	5.40	5.3
Sun.	6	6.30	12 20 AM	5.40	5.35
Mon.	7	6.30	1.20	5.40	5.35
Tue.	8	6.30 LQ	2.20	5.40	5 35
Wed.	9	6.30	3.10	5.40	5.35
Thu.	10	6.30	3.50	5.40	5.35
Fri	11	6.30	4.30	5.40	5.35
Sat.	12	6.30	5.10	5.50	5.20
Sun.	13	6 40	5.10	5.50	5 20
Mon.	14	6.40	5.10	5.50	5.20
Tue.	15	6.40	5.10	5.50	5.20
Wed.	16	6.40 NM	5.10	5.50	5.20
Thu.	17	6.40	5.10	5.50	5.20
Fri	18	6.40	5.10	5.50	5.20
Sat.	19	6.40	5.10	6.00	5.10
Sun	20	6.40	5.00	6 00	5.10
Mon.	21	9 40	5.00	6.00	5.10
Tue.	22	10.40	5.00	6.00	5.10
Wed.	23	11.40	5.00	6.00	5.10
Thu.	24	12.30 AM FQ	5.00	6.00	5.10
Fri.	25	1.20	5.00	6.00	5.10
Sat.	26	2.10	5.00	6.10	4.55
Sun.	27	2.50	4.50	6 10	4.55
Mon.	28	3.40	4.50	6.10	4.55
Tue.	29	No L.	No L.	6.10	4.55
Wed.	30	No L FM	No L.	6.10	4.55
Thu.	31	No L.	No L.	6.10	4.55







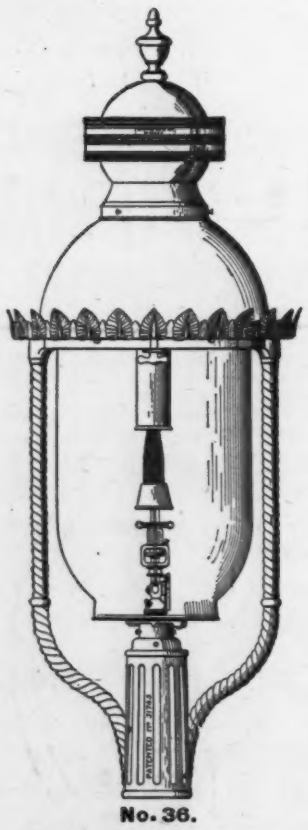
TOTAL HOURS LIGHTING DURING 1904.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	225.00	January	423.20
February	205.40	February	367.40
March	187.40	March	355.35
April	169.50	April	298.50
May	152.30	May	264.50
June	137.20	June	234.25
July	138.50	July	243.45
August	151.00	August	280.25
September	164.40	September	321.15
October	191.30	October	374.30
November	210.30	November	401.40
December	237.10	December	433.45
Total, yr.	2171.40	Total, yr.	4000.00

NEW YORK, 33 Nassau Street. BOSTON. 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting.

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple-

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

The genuine Welsbachs---Burners or Mantles---make satisfied customers---keep customers---MAKE NEW ONES.

And your profit isn't merely dollars and cents.

WELSBACH CO.,

Broad and Arch Sts., PHILADELPHIA.

THE UNITED GAS IMPROVEMENT COMPANY

For the Year Ending December 31, 1903, has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

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Baltimore, Md.	Lynn, Mass.	New York (Central Union Co.)
Chicago, Ills.	Newark, N. J.	Cicero, Ills.
Amesbury, Mass.	Washington, D. C.	Chicago (Ogden Co.)
Aberdeen, S. D.	Boone, Ia.	Easton, Pa.
Winsted, Conn.	Pueblo, Col.	Lawrence, Mass.
Canon City, Col.	Charlotte, N. C.	Council Bluffs, Ia.
Schenectady, N. Y.	Fall River, Mass.	Chattanooga, Tenn.
Hagerstown, Md.	Duluth, Minn.	Tuckerton, N. J.
Malden, Mass.	New York (Mutual Co.)	Springfield, O.
Bridgeport, Conn.	Waltham, Mass.	Easton, Pa. (2d contract).
Albert Lea, Minn.	Dover, Del.	Mobile, Ala.
Brooklyn, N. Y.	York, Pa.	Conshohocken, Pa.
Kansas City, Kas.	Minneapolis, Minn.	Mason City, Ia.
Hempstead, N. Y.	Allentown, Pa.	

TOTAL SETS FOR 1903, ... 62
TOTAL DAILY CAPACITY, ... 62,950,000 cubic feet.
TOTAL SETS TO DATE, ... 508
TOTAL DAILY CAPACITY, ... 362,780,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

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Greene & Essex Streets,
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FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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FLEMMING GENERATOR GAS FURNACE

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MANUFACTURERS OF

CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

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Fire Brick Manufg. Co.,

Manufacturers of { CAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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Established 1845. Reorganized 1902.

The Kreischer Brick Mfg. Co.,

Manufacturers of the very best quality of Clay Retorts, Blocks, Tiles, Settings and Firebrick of every description.

Also Miners and Shippers of Fireclay, Fire Sand, Ground Brick in Barrels.

WORKS: KREISCHERVILLE, STATEN ISLAND.
OFFICE: 119 E. 23D STREET, NEW YORK CITY

CONSOLIDATED GAS CO. OF NEW JERSEY, LONG BRANCH, N. J., September 28th, 1903.

ADAM WEBER SONS,
Park Row Building, New York City:

GENTLEMEN—In answer to your inquiry of even date, in regard to the condition of our 5 benches of 6's, I would say that, during the 33 months in which these benches have been in use, we have produced 248,000,000 cubic feet of gas from them. During this period 24 retorts were in use for 18 months, and 30 retorts for 15 months. The average number of retorts in use during the entire period was 26.7. The average make per retort for the 33 months was 9,325,000 cubic feet. We expect to run these benches for 3 months more, and we estimate that our make of coal gas for the 36 months will amount to 269,600,000 cubic feet, or 10,060,000 cubic feet per retort.

As far as we can see at the present time, it will only be necessary for us to put in new retorts in resetting these benches, as the furnace blocks and recuperative flues are in very good condition.

Yours very truly,
(Signed) W. B. TUTTLE,
General Manager.

ISAAC C. BAXTER, President. ESTABLISHED 1864. PETER YOUNG, Sec'y and Treas.

Works.
LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

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JAMES GARDNER, JR., CO., Room 202 Lewis B'l'd'g.
PITTSBURGH, PA.

Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

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A. M. CALLENDER & CO., 42 Pine Street, New York City.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

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RETORT & FIRE BRICK CO.

MANUFACTORY AT
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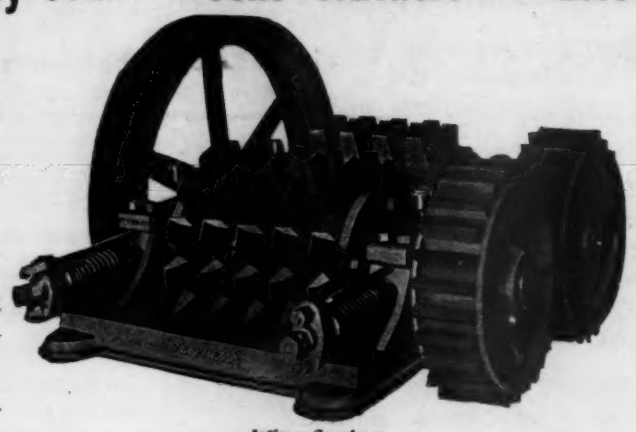

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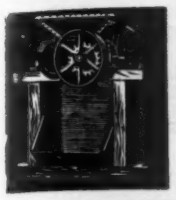

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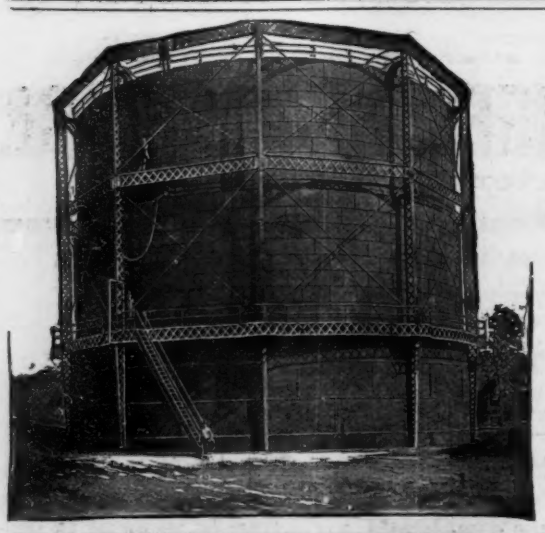

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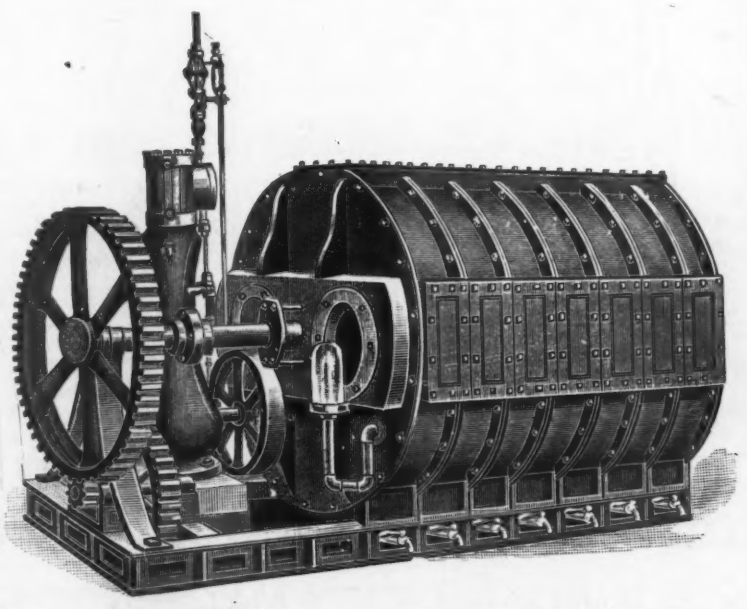

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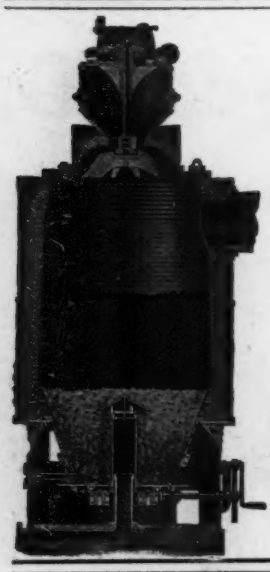

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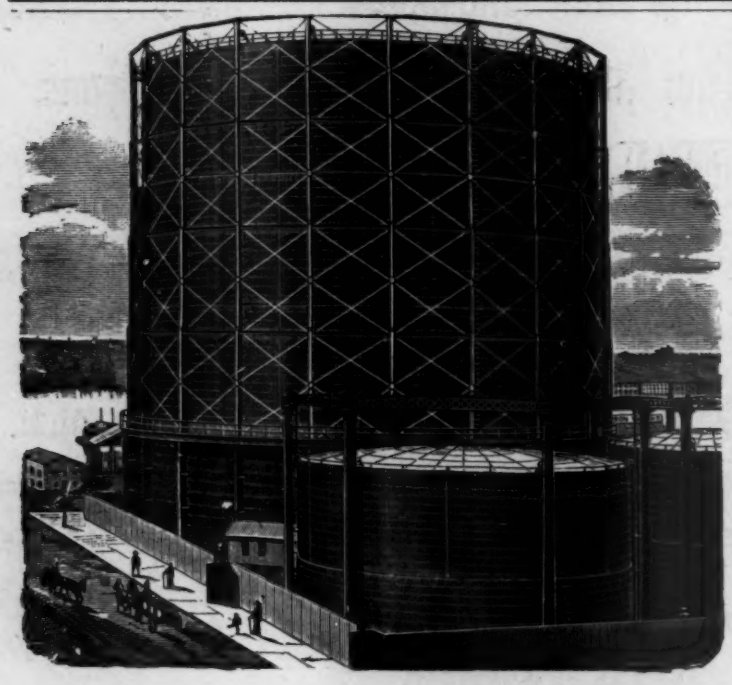

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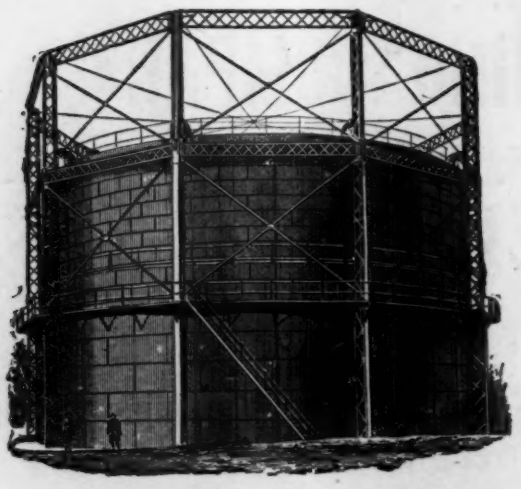

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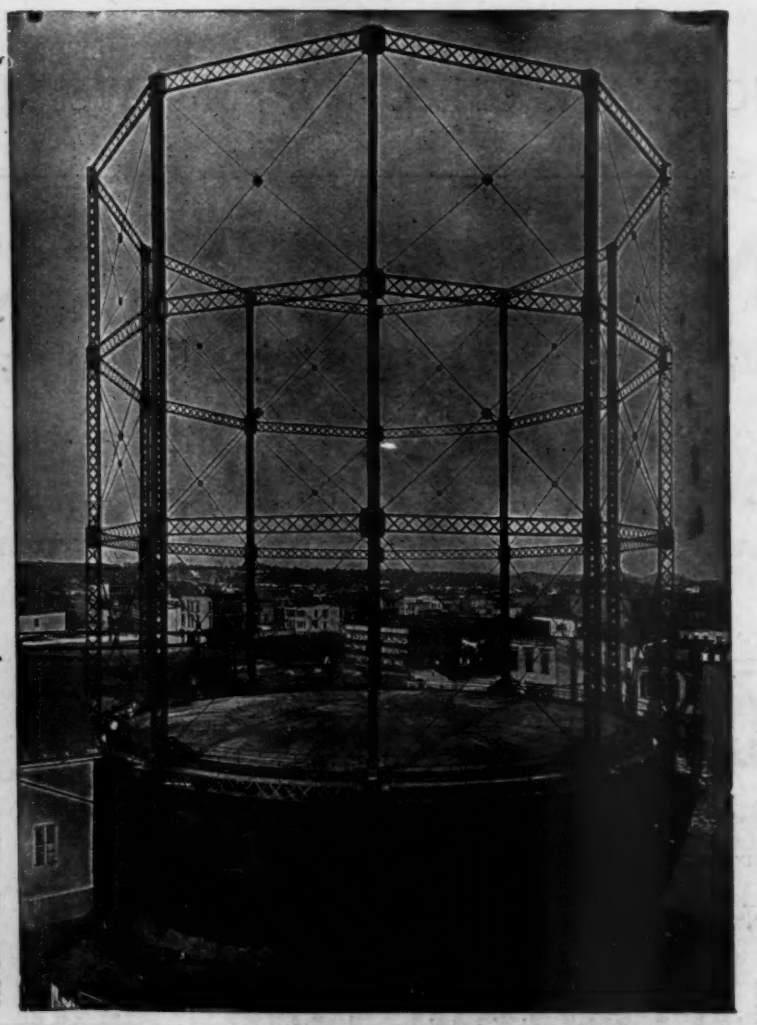

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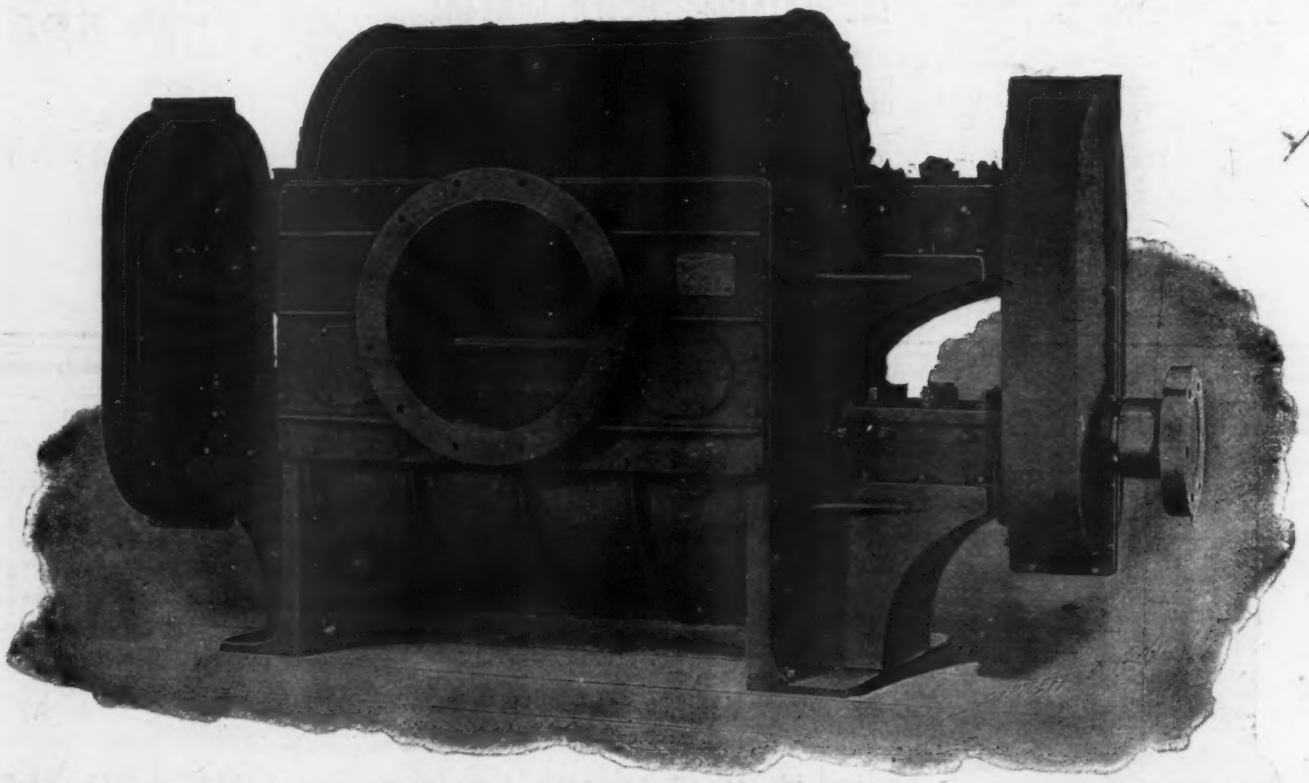

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